ACI NORTH AMERICA
AIRPORTS COUNCIL INTERNATIONAL

AIR CARGO GUIDE

ACI-NA Air Cargo Committee

November 2025

Back to Table of Contents

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ACI-NA's Air Cargo Committee's Air Cargo Guide is intended to provide general, practical information to airport officials and others involved in air cargo development. It does not constitute professional technical or legal advice and users should not rely on it as a sole source of information. ACI-NA, the authors and contributors disclaim liability for any such reliance. In no event shall ACI-NA or the authors and contributors be liable for consequential damages because of the use of the ACI-NA Air Cargo Guide.

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Back to Table of Contents

Airports Council International – North America Air Cargo Committee Chair's Greeting

November 2025

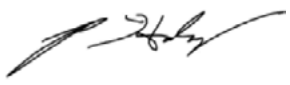
Greetings from the beautiful Pacific Northwest! Serving as the 2024-2025 Chair of ACI-NA's Air Cargo Committee, I am proud to present this updated version of the ACI-NA Air Cargo Committee's Air Cargo Guide. The original 1995 document quickly became an imperative tool for many airports to learn about this important segment of the air transportation industry. This version continues to meet the needs of all sizes and types of airports that are interested in understanding, supporting and growing their air cargo portfolio. It provides up to date information from air cargo professionals from airports, academia and consulting firms.

This Guide consists of ten chapters covering a range of important cargo issues confronting airports. In several chapters, there is an overlap of similar issues to address important topics from different perspectives. This is consistent with the intent of the original document: to provide airports with an understanding of different strategic issues fundamental to air cargo. This Guide is not intended to provide all the answers; it has been written to help users formulate the right questions.

The Air Cargo Committee began as a sub-committee of ACI-NA's Economics Committee dating back in 1991. However, in the ensuing years it has matured and grown to full ACI-NA Committee.. Through the active participation of its airport and associate members, the Committee delves into a broad spectrum of cargo related issues and their effect on airports the intermodal transportation of goods and associated land development. In addition to its **Steering Group** (providing direction and leadership), the Committee has expanded in the past decade to include an **Industry Affairs Working Group** and a **Membership Engagement Working Group**. These two standing working groups develop the content the Steering Group requests to support the entire Committee and Air Cargo community. The Committee addresses important subjects including security and other regulatory mandates, international air service, U.S. and Canadian freight policies and management strategies relating to cargo operations. This guide is an enduring and modern tool encompassing the Committee's efforts to provide a comprehensive understanding of the important issues in the air cargo environment. This work is supplemented and updated through semi-annual conferences, forums, video presentations, white papers, webinars and quarterly roundtables that exchange information among the membership along with promoting other air cargo partners including airlines, integrated carriers, forwarders and shippers in the global supply chain community.

I wish to personally and formally acknowledge the past and current contributors. These professionals contributed their time and effort to this updated version of the Guide. They are clear examples of the energy, commitment, and breadth of knowledge of the Air Cargo Committee.

This Guide is an ideal instrument to expand the knowledge base of interested air cargo professionals at airports and throughout the industry. With this resource, airports can benefit and enhance local and regional economies through growth in their supply chain and trade. As our industry constantly evolves and creates new challenges for airports to confront, it is our hope that you will continue to participate in the exchange of ideas contained within this updated edition of the Air Cargo Guide and with the ongoing activities of the Committee. We welcome your suggestions on how the ACI-NA Air Cargo Committee can better serve your needs.



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Back to Table of Contents

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This Air Cargo Guide is the fifth edition of the document. It represents a collaborative effort by member airports and associate members that have produced a high-quality product offering a solid balance of viewpoints from different industry elements. Our sincerest thanks go to the talented individuals who worked on the original project and subsequently updated versions. We hope all those who have previously used this Guide recognized the value of their contribution.

As was the case with the original, the chapters were reviewed, revised or (in the case of new sections) edited to reflect the experience and knowledge the industry has gained over the past five years and the changes that have impacted the global dynamics of air cargo. Once again, the finished product reflects the quality and hard work of our members. All the individuals are listed as with the entity at the time when they worked on the Air Cargo Guide.

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Back to Table of Contents

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Back to Table of Contents

Contents

Back to Table of Contents

Chapter 1

Air Cargo: Industry Background and Key Trends

Back to Table of Contents

1. Air Cargo: Industry Background and Key Trends

1.1 Introduction

Air cargo comprises all freight and mail moved by air but excluding passenger baggage. Air cargo accounts for about 1 percent of total freight by weight transported by all modes worldwide, but about 35 percent of total freight value. While true that high-value commodities tend to move by air and relatively low-value products more likely are transported by truck, train, and/or ship, the value/weight proposition does not wholly define the air cargo industry's demand drivers.

1.2 Attributes of Air Cargo

While an undeniable relationship exists between a product's value and its propensity to be shipped by air transportation, the demand drivers for air transport are more nuanced than a simple functional relationship between relatively high-value commodities and the willingness to pay much higher costs for air transport.

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 fruits and vegetables, life science products, and seasonal products that must meet very specific delivery deadlines.

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 chain of custody.

Cost of Capital & Inventory Cost

High-value commodities consume large amounts of capital and impose high interest costs on 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. Shippers do not care about transportation mode specifically but about the consignment reaching its intended destination on time and in good condition.

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

1.3 Modal Choice

Most of the academic research incorporates a total distribution cost (TDC) framework to quantify the effect of transportation decisions on the total costs of manufacturing and distributing a product. 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 expenses. Accordingly, this section will present the most important factors governing modal choice and discuss how each factor operates and interacts with the others.

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

Back to Table of Contents

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. An example of physical perishability would be strawberries, which spoil (even with refrigeration) within two weeks of harvesting. Some products suffer both types of perishability. Red roses 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. Similarly, pharmaceutical products have become a major element in air cargo growth.

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. To avoid lost selling opportunities (stock-outs), shippers 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. An unexpected box-office smash film will cause manufacturers to swiftly license, manufacture and distribute the products to exploit temporary fads.

Geographic market transportation factors

Factors unique to 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. Also, markets with sharp directional imbalances in air cargo demand can have unique and sustained airlift pricing distortions. For example, westbound traffic and yields in most transpacific markets are multiples of eastbound volumes and rates. Carriers fly from the U.S. to Asia to take advantage of the lucrative return trip. Accordingly, the airlines offer steep discounts on positioning flights and such "backhaul" pricing can upgrade commodities that 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 but rather could use either air or surface transportation depending on the cost-speed-reliability-security tradeoffs. Of course, not all 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) than 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 shipments. "Just-in-time" manufacturing does not immediately imply the involvement of air shipments but only suggests that 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.

1.4 Air Cargo Business Models

According to the *Boeing World Air Cargo Forecast 2024-2043*, there were 2,845 freighters in operation worldwide. 30% of these were large wide body (>80 tons) aircraft, 27% were medium wide-bodied aircraft (40 to 80 tons) and 43% were standard bodies with carrying capacities of less than 45 tons. Boeing projects the demand for the world freighter fleet to increase to 3900 airplanes by 2043. This expected demand will be met

Back to Table of Contents

through new production freighters and conversion of passenger aircraft to cargo aircraft.

There are several business models in the air cargo industry. The predominant ones include the all- cargo carriers, the integrators that control aircraft and trucking networks to deliver cargo from point to point rather than airport to airport, pure belly cargo (passenger) airlines and combination carriers that operate both passenger and freighter aircraft.

All-cargo carriers

All-cargo carriers operate dedicated fleets of freighter aircraft. While some all-cargo carriers operate their own schedules and networks, ACMI (aircraft, crew, maintenance and insurance) carriers operate schedules and networks stipulated by clients that may include other scheduled airlines and large freight forwarders. While stand-alone, all-cargo carriers have become rarer in the last 30 years, ACMI carriers have grown in significance due to their prevalence on behalf of Amazon and for DHL's U.S. network.

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 have fleets of ACMI leased freighters of 50 aircraft plus each, astonishing growth in a small period. 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 integrators typically own and operate their entire logistics network from aircraft to sorting hubs and associated infrastructure to ground transportation vehicles and infrastructure needed to deliver the cargo to its final destination.

Combination carriers

Combination carriers fly both passenger and freighter aircraft. Similar to 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 Alaska, 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.

Allied Service Providers

Although not air carriers, a variety of cargo operators are critically important to the functioning of the air cargo industry, especially at international gateways.

Often described as "the travel agents of cargo", freight forwarders (also known as Indirect Air Carriers) serve as intermediaries between the shippers (manufacturers and distributors) and transportation providers of all modes or in some cases, specialize in individual modes. Among many functions, forwarders consolidate many small shipments from their customers into pallet size loads, essentially buying cargo space wholesale from the air carriers and selling retail to their customers. Working with freight forwarders, all-cargo carriers often enter long-term contracts, which provide 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.

Whether operating the cargo function within a comprehensive menu of ground-handling services or finite services narrowly focused on cargo, handling operations are diverse both within a larger airport and across the industry. Depending on the stipulations of their contracts with airline-clients, cargo handlers may load and unload aircraft, tow cargo between the aircraft ramp and warehouses, build and break pallets of cargo in the warehouse and even handle import and export documents. Decades ago, air cargo carriers tended to perform these functions at North American airports but at least since the 1980s, these functions have increasingly been outsourced to operators such as Alliance Ground International (AGI), dnata, Menzies

Back to Table of Contents

Aviation, Swissport and Worldwide Flight Services (WFS). By maximizing their use of warehouse space, equipment and labor, 3rd party handlers allow cargo to be carried by passenger and all-cargo airlines that may not generate enough tonnage to justify investments in those resources otherwise.

2. Key Trends in Air Cargo

2.1 Introduction

Of the top twenty U.S. cargo airports ranked by annual tonnage for calendar year 2024, roughly half were national and regional hubs for FedEx Express (FX), United Parcel Service (UPS) and more recently Amazon. These include national hubs like Memphis International Airport (MEM) for FedEx Express, Louisville Muhammad Ali International Airport (SDF) for UPS and Cincinnati/Northern Kentucky International Airport (CVG) which serves as the U.S. national hub for both DHL and Amazon. FedEx Express also has a bypass hub at Indianapolis International Airport (IND), as well as regional hubs at Oakland International Airport (OAK), Newark Liberty International Airport (EWR) and Fort Worth Alliance Airport (AFW). UPS also has regional hubs at Philadelphia International Airport (PHL), Chicago Rockford International Airport (RFD), Dallas Fort Worth International Airport (DFW) and Ontario International Airport (ONT). In addition to its CVG hub, Amazon also operates substantial hubs at San Bernardino International Airport (SBD) and Fort Worth Alliance Airport (AFW).

The balance of top twenty U.S. cargo airports were largely international gateways, led by four – Miami International Airport (MIA), Los Angeles International Airport (LAX), Chicago O'Hare International Airport (ORD) and New York JFK International Airport (JFK); with more balanced mixes of international belly capacity provided by passenger airlines operating widebody long-haul aircraft and dedicated freighters. Other international gateways ranked in the top twenty are much dominated by passenger hub airlines – such as Delta Air Lines at Hartsfield-Jackson Atlanta International Airport (ATL), American Airlines at DFW and United Airlines at San Francisco International Airport (SFO). A unique entry among the leading U.S. cargo airports is Anchorage International Airport (ANC) which has historically served as a transpacific tech-stop for refueling and crew changes on long-haul routes between Asia and North America, but which also serves as a sortation center for Amazon, DHL, FedEx Express and UPS serving the same continental markets.

Although integrators have conventionally sought less congested alternatives to major gateways – such as FedEx Express' choices of OAK instead of SFO and AFW instead of DFW, as well as UPS's choice of ONT instead of LAX. DFW, EWR and PHL share the distinction of being major hubs for passenger airlines and regional hubs for integrated cargo carriers. Because FedEx Express, UPS and Amazon control their own air and ground networks and perform their own handling operations (or in the case of Amazon, can demand handlers dedicate unique resources to their operation), these carriers have been successful in establishing substantial operations at alternative airports that have been less successful in sustaining non-integrated airlines.

Successful alternative international gateways have been rare, with Huntsville International Airport (HSV) having almost solely provided the example for decades that other airports attempted to emulate. More recently, Greenville-Spartanburg International Airport (GSP) has achieved substantial international cargo growth in support of regional manufacturing operations of BMW and other industrial users. Both HSV and GSP serve regional demand that otherwise may have been likely to have been served by ATL. Similarly, RFD and Columbus, Ohio's Rickenbacker International Airport (LCK) have international freighters that otherwise would have been likely operated at ORD.

While the majority of top twenty U.S. cargo airports are integrator hubs and international gateways, most commercial airports provide neither of those functions but serve critical needs for their local and regional origin-and-destination constituents whether businesses or end consumers. These range from very large airports that are passenger hubs serving large metropolitan areas (like Denver and Phoenix), as well as numerous airports served only by small feeder aircraft operating on behalf of the integrators. As was demonstrated during the pandemic, when time-sensitive vaccines saved lives across the globe, effective air cargo operations are critical to communities of all sizes. In some cases, the integrators have utilized small alternative airports to serve the demand of accessible much larger metropolitan areas. For example, the Greater Boston air cargo market is principally served by Boston Logan International Airport (BOS) for the most time-sensitive overnight shipments, while less timely regional demand may be routed over less congested Manchester-Boston Regional Airport (MHT), Rhode Island T.F. Green International Airport (PVD) and Bradley International Airport (BDL). Similarly, Lehigh Valley International Airport (ABE) has been used by Amazon and FedEx Express to accommodate southeastern Pennsylvania demand unmet at PHL.

Back to Table of Contents

2.2 E-commerce Growth

The explosive growth of e-commerce has already greatly increased demand for air cargo and is projected to lead growth in the near-term planning horizon. While much of this growth is commonly associated in the U.S. with Amazon which has visibly impacted U.S. warehouse and roadway utilization, e-commerce has also dramatically impacted the other integrated carriers, as well as passenger airlines operating cargo-friendly widebody aircraft on long-haul transcontinental routes. The impact on the integrators has been fluid as FedEx Express was first to terminate its services with Amazon as a prospective competitor but more recently has been more amenable to that very large customer. In contrast, UPS first seized upon FedEx Express' unavailability to Amazon to grow that business but has now reduced its capacity available to Amazon. UPS has also recently replaced FedEx Express for a major contract with the U.S. Postal Service, which has its own fluid relationship as a first and last mile provider to Amazon. Eventually, other U.S. entities like Walmart or Target may be tempted to develop their own air networks. Amazon-style e-commerce companies in China have already expanded to global footprints of enough magnitude to motivate protectionist tariff policies in the U.S. that are (as of this edition) wreaking havoc across parts of the global air cargo industry. The unpredictability of the current trade environment has also produced beneficiaries among operators able to provide emergency capacity on short notice.

2.3 Temperature Controlled Goods – Perishable Foods and Pharmaceuticals

Demand for fresh foods has been on the rise in developed countries, 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 this growth. Improvements have included the development of specialized shipping containers, real-time temperature monitoring devices and purpose-built air cargo facilities. However, the more specialized warehouse facilities are, the more challenging they can be to find replacement tenants when former operators fail or simply leave the local market. Moreover, the emphasis on expedited handling is intended to minimize the dwell-time of perishables in airport warehouses, such that in many markets temperature-controlled facilities are mostly expensive insurance policies. Airport operators are advised to be conservative about speculative investments in these facilities.

Even before the COVID-19 pandemic from 2020 to 2023, the healthcare needs of an aging global population were already driving air cargo demand with the most stringent process requirements of any commodity type. While individual carriers and cargo handlers have invested heavily in specialized life sciences-oriented facilities in their own proprietary warehouses, operators like Brussels Airport (BRU) have also made substantial commitments to their partners in the pharma industry. Successful development drove an evolution of process and standards which was recognized and adopted by the International Air Transport Association (IATA) which now offers certification globally with over 160 companies certified. Some ACI-NA member airports in the U.S. and Canada are 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 an airport's current or prospective air carrier customer base.

2.4 Emerging Technology: Cargo Community Systems (CCS)

The air cargo operating environment comprises multiple types of commercial operators (e.g., airlines, trucking companies, cargo handlers, freight forwarders) and government regulators (e.g., customs, food and drug inspectors). The more efficiently that these diverse players can be coordinated, the timelier sensitive cargo can be transported to end-users. The less redundant data must be entered, the fewer opportunities for errors. The more transparent these activities can be made, the more effective planning can be performed by all concerned. The preceding functions and objectives can be facilitated by Cargo Community Systems (CCS).

Very broadly, a CCS is a digital platform that provides single-window means of communications

between the air cargo supply chain stakeholders, enabling real-time data sharing and automation. By improving communications and collaboration throughout the supply chain, the CCS enhances security and efficiency with potential benefits to labor utilization and sustainability.

While broad definitions of a CCS are possible, the situational realities must be evaluated on a case-by-case basis. Participation in these systems is largely voluntary, especially in the U.S. where regulatory agencies specifically have declined to participate. Moreover, airport-wide CCS technology is justifiably resisted by integrators that have their own very expensive IT systems and control their own handling and trucking

Back to Table of Contents

interfaces with their air operations.

The potential applications that could be leveraged are far broader than what has been implemented in many markets. The CCS can share data originating from a shipper or forwarder in a foreign market with an on-airport handler, then an airline, a handler at the destination airport, customs brokers in the destination market, trucking companies in the destination market and then the consignee in the destination market, as well as regulators. However, the same platform is often used strictly as a payment system between two parties in that chain. In the U.S., the CCS may be used simply as a truck management system between on-airport handling warehouses and trucking companies.

2.5 Emerging Technology: Unmanned Aircraft Systems

Unmanned aircraft systems (UAS): colloquially referred to as "drones" have natural applications to the logistics industry but their development remains at a relatively early stage. Transporting products and packages via drones clearly entails less risk than transporting people and commercial applications have already been tested in the form of e-commerce shipments. Companies such as Amazon, China's JD.com, Wing, among others are currently developing and testing cargo UAS in expanded roles. These companies are optimistic that using UAS 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 developing industry, but this appears to be a temporary obstacle, especially as other countries already allow liberal use of UAS. In more densely populated metropolitan areas, especially in the vicinity of busy commercial service airports, airspace and other safety concerns exist.

Back to Table of Contents

Chapter 2

Developing an Air Cargo Market

Back to Table of Contents

1. Introduction

Air cargo, which has traditionally received less attention than passenger aviation, has gained prominence due to the growth of e-commerce, the impacts of the COVID-19 pandemic and geopolitical issues impacting global supply chains. These shifts have raised expectations for faster and reliable deliveries, making marketing crucial in positioning air cargo as a key player in global trade.

Airport marketing plans should showcase regional market strengths, facilities and service infrastructure, while considering factors like government agencies, access routes, warehousing, and ramp space. Marketing efforts should also align with facility infrastructure development plans to gain new or expanded business with economic benefits for their region. The marketing plan should set targeted objectives, define audiences, and create strategies that attract customers and meet operational aims.

Airlines and freight forwarders have also expanded their marketing efforts and now use digital marketing and customer-oriented tactics to highlight their services, maintain and gain customer trust. Additionally, airlines prioritize strategic partnerships with freight forwarders and logistics companies to expand service networks and improve operational efficiency.

Through these multifaceted strategies, airports and airlines continually grow their air cargo business and position themselves as vital contributors to global supply chains.

It is important to note that the marketing and development strategies outlined below provide only a current perspective, as the air cargo industry continues to evolve ongoing changes within the sector necessitate regular review and adaptation of these strategies.

2. Importance of Air Cargo to the Region

Airports are powerful economic engines that attract major industry to a region, playing a pivotal role in supporting and expanding the local economy through air cargo operations. By providing essential connectivity to global markets, airports enable just-in-time logistics for manufacturers, facilitate the rapid movement of high-value and time-sensitive goods, and help local businesses compete internationally. The presence of a robust air cargo infrastructure encourages investment from manufacturers and logistics companies, directly creating jobs and generating significant economic output while indirectly fostering growth in related sectors like warehousing, distribution, and advanced manufacturing. This dynamic synergy between airports and regional industry not only drives GDP growth but also elevates the area's reputation as a key gateway in the global supply chain.

Examples of economic impact relating to airport proximity include:

- In 2009 Kia Automobiles opened a new car plant in West Point Georgia just 50 miles southwest of Hartsfield-Jackson Atlanta International Airport (ATL). The proximity of the airport and its cargo operations offered just-in-time shipments to this new car assembly plant and the 4,000 workers. The addition of this car assembly plant not only had a $4 billion economic impact on the state of Georgia, it also added new cargo capacity to the Atlanta market when Korean Airlines added additional frequencies along with ASIANA Airlines beginning service to ATL with daily all-cargo flights.
- A compelling recent example is JetZero's decision in 2025 to establish a $4.7 billion airplane manufacturing hub at Piedmont Triad International Airport (GSP) in Greensboro, North Carolina. This facility, which will produce the innovative Z4 blended-wing body jet, is expected to create over 14,500 jobs and generate a projected $259 billion economic impact over the next 37 years. The proximity to the airport was a key factor in JetZero's site selection, offering logistical advantages for cargo operations, workforce mobility and infrastructure support. This transformative investment not only strengthens North Carolina's aerospace cluster but also enhances the airport's role as a regional economic engine.
  - https://governor.nc.gov/news/press-releases/2025/06/12/governor-stein-announces-jetzero-selects-north-carolina-4-billion-airplane-manufacturing-hub
- Similarly, the South Carolina Technology and Aviation Center (SCTAC) in Greenville, located near a general aviation airport, has become a hub for advanced manufacturing. Home to over 100 companies including Lockheed Martin, Michelin and 3M, SCTAC contributes $6.1 billion annually to the state's economy and supports over 8,000 high-paying jobs. The presence of the airport and supporting infrastructure has been instrumental in attracting and sustaining these operations, reinforcing the airport's role in regional development.

Back to Table of Contents

  - https://www.greenvilleonline.com/story/news/2024/12/09/greenville-business-park-has-6-1-billion-impact-on-sc-study-shows/76860044007/

- The Pearson Economic Zone (PEZ) in Ontario encompasses five municipalities: Mississauga, Brampton, Caledon, Toronto and Vaughan; covering 200 square kilometers. This area hosts over 18,000 companies, representing one of North America's largest manufacturing concentrations. Approximately 500,000 jobs, with growth of 100,000 positions since 2016 and an annual GDP of $70.6 billion, with Toronto Pearson Airport (YYZ) accounting for $19.6 billion of that total.
- Manufacturers within the PEZ are engaged in diverse sectors, producing aircraft engine components, space robotics, and consumer products. The airport's strategic connectivity to 70% of the global economy supports just-in-time logistics, robust export activity, and effective talent recruitment.
- Air cargo operations at Toronto Pearson Airport (YYZ) and within the PEZ offer unparalleled flexibility and speed for businesses seeking to move high-value, time-sensitive goods. The ability to quickly import and export pharmaceuticals, electronics, automotive parts, and perishable foods makes the region a vital node in global supply chains. Furthermore, the concentration of freight forwarders and logistics providers at the airport ensures competitive rates and customized solutions for shippers. These benefits not only bolster the region's economic growth but also enhance its reputation as a premier gateway for international commerce.
  - https://www.iamtorontopearson.com/news-and-events/by-the-numbers-pearson-economic-zone
- Calgary's YYC Global Logistics Park, a 330-acre development adjacent to Calgary International Airport (YYC), is establishing itself as a premier North American hub for manufacturing and distribution. As Canada's fifth-largest cargo airport, YYC offers advanced freight handling, consolidation and forwarding services. Its Foreign Trade Zone (FTZ) designation enables businesses to defer taxes and tariffs, enhancing the region's appeal for industrial enterprises.
- YYC Global Logistics Park is rapidly emerging as a catalyst for economic growth and innovation in Calgary. The airport's sophisticated cargo operations facilitate reliable, rapid shipping, enabling local firms to access international markets efficiently and respond quickly to customer requirements. This strong connectivity attracts new industries, fosters employment, and reinforces supply chain resilience across Alberta and Western Canada. Furthermore, the airport's infrastructure and strategic partnerships solidify Calgary's standing as a North American Center for manufacturing, distribution, and innovation, positioning the city at the forefront of contemporary commerce.
  - https://investalberta.ca/aviation-logistics/

3. Assessing the Market

Airports may believe that having a runway enables them to effectively serve the air cargo segment, but this is not always accurate. Numerous variables influence the potential success of air cargo operations. These factors include the physical capacity of the airport, both landside and aeronautical infrastructure, characteristics of regional consuming and producing markets, roadway access, redistribution capabilities by air or land, aircraft capacity and the presence of competing airports. Even if several of these attributes are present, implementing air cargo service can remain challenging for many airports.

A robust air cargo infrastructure delivers significant benefits to both airports and the broader regional economy. It is critical for airports to recognize that balanced inbound and outbound tonnage is generally necessary for sustained cargo service viability.

Logistics often means managing shipping chains; the series of firms moving a product from origin to consumer. Given the relative cost of trucking cargo versus flying cargo, shippers and manufacturers are more than willing to put their products on trucks to be taken to the most economical and efficient airport from which to ship by air. Airports can also lose cargo volume (leakage) due to overcapacity at competing airports or because airlines at destination airports have too many flights and not enough cargo to fill them.

Much of the air cargo traffic is influenced by freight forwarders, who typically take the following factors into account when determining air cargo bookings:

Availability of Air Service

The routing decision often depends on whether direct airlift to service points is available. Shippers and air

Back to Table of Contents

freight forwarders commonly select delivery to the final flight's origination point rather than relying on connecting flights from local airports.

The presence of direct air service can enhance a region's appeal for manufacturers by providing efficient channels for products or components to reach the market quickly.

Compatibility of Aircraft Capacity

Shipments may be limited to specific aircraft types based on their commodity. Some cargo, such as oversized items, hazardous materials or live animals, can require wide-body main deck or all-cargo configurations. Shippers and agents sometimes indicate a preference for additional airline options to a given destination.

Economies of Consolidation

Many large international forwarders employ the "gateway" concept, consolidating regional air cargo shipments at a single gateway airport, which enables them to negotiate rates with air carriers for larger volumes. This also allows for efficient use of unitized capacity by combining varying types of cargo.

Total Cost and Time Efficiency

Certain commodities, including fresh seafood, flowers, pharmaceuticals, emergency parts or items for Just-In-Time manufacturing, are more time sensitive. In addition, global competition may result in price sensitivity for these goods. Shippers may therefore consider total cost and delivery speed when selecting airport routes for these shipments.

Service Market Information

In the air cargo industry, shippers and forwarders require timely and reliable service information. While an airport may offer advantages such as service availability, accessibility, or infrastructure, these benefits might not always be known in the shipping community. It is important for shippers to be informed about the competitive strengths and advantages of your airport.

4. Customer Segments

There are three primary customer segments for an airport's air cargo operations

Air Carriers (as Customers of the Airport):

- Air carriers, both cargo-only and passenger airlines with belly cargo, are direct customers of the airport. Their role includes:
  - Leasing cargo facilities and apron space
  - Paying landing, parking, and handling fees
  - Driving infrastructure investment (e.g., cold chain, warehousing, customs zones)
  - Influencing route development and cargo connectivity
- Airports depend on carriers to maintain and grow cargo throughput. In turn, carriers rely on airports for efficient ground handling, customs clearance and access to regional markets.
- To advance air cargo offerings, airlines have expanded their use of targeted omnichannel digital advertising, active participation in global trade conferences (both virtual and hybrid), and dynamic social media engagement that spotlights operational reliability, sustainability and global network reach.
- Leading carriers have invested in specialized solutions, such as advanced temperature-controlled shipping, expedited urban delivery through drone integration, IoT-enabled tracking and e-commerce fulfillment; all to meet diverse client needs.
- Airlines educate stakeholders using interactive webinars, on-demand video resources, and sponsored industry summits to communicate the latest enhancements in their cargo products. Enhanced API-driven booking systems, real-time digital shipment visibility, AI-powered customer support, and a commitment to carbon neutrality, including sustainable aviation fuel adoption and reusable eco-packaging, are now standard practices to appeal to environmentally responsible customers.

Back to Table of Contents

Marketing plan tactics:

- Primary focus on senior management of both domestic and international airlines
- Business meetings, presentations, and informational programs emphasize the airport's cargo advantages and connectivity
- Digital marketing and collaborative initiatives showcase infrastructure and partner opportunities
- Examples: Virtual events and online campaigns targeting airline decision-makers

Freight Forwarders and Logistics Providers

- These are the largest users of air cargo services. They act as intermediaries between shippers and airlines, managing the movement of goods across borders. Their roles include:
  - Consolidating shipments
  - Booking cargo space with airlines
  - Handling customs and documentation
  - Providing end-to-end logistics solutions
- They are critical to maintaining cargo volumes and optimizing airport cargo infrastructure.
- Air freight forwarders continue to be essential players in the air freight ecosystem. They consolidate shipments from a broad range of shippers, select optimal airline services and handle advanced airway bill documentation, now fully integrated with Electronic Air Waybill (E-AWB) and blockchain-enabled platforms. These innovations have further eliminated paperwork, enhancing transparency, security and efficiency across the air cargo process. In international operations, forwarders now utilize advanced e-customs and AI-powered compliance tools to streamline customs clearance and ensure rapid final delivery. Recent studies show that routing decisions are still primarily led by forwarders and brokers, while automation and digital collaboration tools have minimized the direct influence of shippers and consignees.

Both airlines and forwarders remain vital to successful airport cargo operations. Their interdependence is strengthened by digital collaboration platforms, with airlines deriving much of their air cargo revenue from forwarders and forwarders choosing gateways based on the availability and quality of real-time, multi-modal air services. This dynamic holds true outside of integrated or express carrier models.

Marketing plan tactics:

- Programs designed to foster relationships with forwarding agents and logistics companies
- Cooperative promotions include joint events, informational luncheons, and networking opportunities to engage potential consolidators
- Marketing content highlights warehouse facilities, road feeder services, and flexible business solutions
- Examples: Trade missions, workshops and collaborative campaigns with logistics associations

Direct Shippers:

- These are businesses that ship goods directly via air cargo, often due to time sensitivity or product value. They include:
  - Manufacturers (e.g., automotive, aerospace, electronics)
  - Retailers and e-commerce firms
  - Pharmaceutical and biotech companies
  - Agricultural exporters
- These customers benefit from the speed and reliability of air cargo, and their demand influences airport cargo capacity and service offerings.

Back to Table of Contents

- For airports aiming to establish long-term direct air cargo operations, marketing efforts should prioritize developing digitally connected manufacturing clusters within or around airport zones. By attracting industries producing high-value, time-sensitive commodities, regions can stimulate business activity and become hubs for dedicated cargo flights.

Marketing plan tactics:

- Targeted events and informational sessions for businesses who ship goods directly through the airport
- Joint programs with freight forwarders introduce current and prospective shippers to airport services and benefits
- Advertising and content marketing underscore efficiency, reliability, and sustainability of cargo operations
- Examples: Case studies featuring successful shipper partnerships and tailored presentations for local exporters

5. The Air Cargo Marketing Plan

Most airports develop comprehensive master plans outlining strategies for air service development. These plans typically define priorities for short, medium and long-term implementation to address the requirements of regional travelers and shippers. As part of this framework, the cargo marketing plan is incorporated as a subset, establishing specific objectives and goals for the airport's air cargo operations and positioning the airport to capitalize on future growth opportunities.

To develop a forward-thinking marketing plan, it is crucial to begin with a thorough evaluation of the regional market landscape and the airport's unique strengths and challenges. This foundation raises key questions:

- What distinctive value does our airport offer today?
- Are we positioning ourselves as an international gateway due to expanded direct links to Europe, Asia, or South America?
- Do our state-of-the-art facilities and strategic location make us an optimal domestic hub with robust multimodal connections, including road feeder services and high-speed logistics corridors?
- Or are we enabling cutting-edge e-commerce fulfillment and sustainable trans-shipment operations?

After these factors have been identified, the next step is to establish a set of overarching objectives that form the foundation for subsequent initiatives, provide justification for future investments, and guide the development of the cargo marketing plan. These goals should be ambitious yet realistic, such as:

- Increasing annual cargo throughput at the airport
- Growing the share of goods handled by airport carriers
- Expanding the number of air freight carriers operating at the airport
- Promoting airport services to encourage new manufacturing companies to locate in the region

With clear objectives defined, the formulation of a cargo marketing plan will outline specific strategies and actions required to achieve these targets. In today's dynamic environment, marketing objectives should focus on areas where the airport can have real impact:

- Expanding All-Cargo and Express Service Networks: Attract new all-cargo airlines and enhance connections with global e-commerce leaders to capture growing online retail volumes.
- Promoting Sustainability Initiatives: Position the airport as a leader in green logistics by advancing carbon-neutral operations, investing in renewable energy infrastructure and offering incentives for eco-friendly carriers and shippers.
- Leveraging Digital Transformation: Implement advanced digital platforms for seamless booking, real-time tracking and data-driven decision making, ensuring transparency and efficiency for all cargo stakeholders.
- Fostering Strategic Partnerships: Collaborate closely with local manufacturers, technology startups,

Back to Table of Contents

and logistics service providers to create industry clusters, especially those specializing in temperature-sensitive, high-value or time-critical shipments such as pharmaceuticals, perishables and just-in-time components.

- Building Workforce and Community Engagement: Invest in workforce development and educational outreach, preparing talent for emerging roles in logistics, automation and data analytics. Engage with the local community to ensure sustainable growth and shared economic benefits.
- Enhancing Resilience and Security: Prioritize robust security measures and resilient supply chain solutions to address new global risks from cybersecurity threats to climate-related disruptions.

A comprehensive air cargo marketing plan should articulate a distinct strategic focus, whether addressing service deficiencies, capitalizing on regional industry assets (such as perishable goods or advanced manufacturing) or initiating innovative logistics solutions. Each strategy must be specifically designed to convey these strengths to key stakeholders, including airlines, freight forwarders, integrators and shippers, highlighting the airport's capability and commitment to meeting the demands and prospects of the dynamic air cargo sector.

These marketing plans necessitate close collaboration with partners such as trucking companies, local and international air cargo organizations, U.S. and Canadian federal agencies, state and provincial aviation authorities and regional economic development bodies. The use of shared analytics and cloud-based information exchange platforms facilitates growth initiatives, supporting both regional objectives and airport expansion.

Applying the **7 Ps of Marketing** to an airport air cargo marketing plan helps structure your strategy to attract and retain cargo operators, logistics partners and freight forwarders. Here's how each principle translates:

1. Product

- **What you're offering**: Air cargo capacity, infrastructure (e.g., warehouses, cold storage), handling services, customs facilitation, and connectivity
- **Focus**: Highlight unique capabilities like specialized cargo handling (e.g., pharma, perishables), speed, reliability and scalability

2. Price

- **Pricing strategy**: Competitive landing fees, handling charges, lease rates for cargo facilities and incentives
- **Focus**: Offer volume discounts, loyalty programs or promotional pricing for new routes or operators

3. Place

- **Distribution channels**: Your airport's geographic location, multimodal connectivity (road, rail) and proximity to key markets
- **Focus**: Emphasize strategic location advantages (e.g., near manufacturing hubs or border crossings) and ease of access

4. Promotion

- **Marketing communications**: Trade shows, digital campaigns, stakeholder engagement and direct outreach to airlines and freight forwarders
- **Focus**: Use case studies, testimonials, and data-driven success stories to build credibility. Collaborate with economic development agencies for joint promotion

5. People

- **Customer-facing teams**: Air service development, cargo operations and customer support
- **Focus**: Train staff to understand cargo needs deeply and foster relationships with key stakeholders.

Back to Table of Contents

Highlight your team's expertise in logistics and regulatory compliance.

6. Process

- **Operational workflows**: Booking systems, customs clearance, cargo tracking and turnaround times
- **Focus**: Streamline processes to reduce dwell time and improve reliability. Promote digital integration and automation.

7. Physical Evidence

- **Tangible proof**: Modern facilities, certifications (e.g., CEIV Pharma), branding and signage
- **Focus**: Showcase infrastructure through virtual tours, brochures and videos. Use KPIs (e.g., throughput, efficiency) to demonstrate performance.

Air cargo marketing comes with a unique set of challenges due to the complexity of the industry, regulatory constraints and the specialized nature of the service. Here are some of the most common challenges:

1. Limited Awareness of Capabilities

- Many stakeholders (e.g., freight forwarders, shippers) may not be fully aware of an airport's cargo capabilities, infrastructure or strategic advantages
- **Solution**: Invest in targeted outreach, educational content and stakeholder engagement

2. Highly Competitive Market

- Airports compete globally for cargo volumes, especially for high-value or time-sensitive goods
- **Solution**: Differentiate through niche services (e.g., pharma, perishables), reliability and multimodal connectivity

3. Complex Stakeholder Ecosystem

- Marketing must address airlines, ground handlers, customs, freight forwarders and shippers; all with different priorities
- **Solution**: Tailor messaging and value propositions for each stakeholder group

4. Regulatory and Security Constraints

- Strict regulations around customs, security and handling can limit flexibility in marketing and operations
- **Solution**: Position compliance and certifications (e.g., CEIV, TAPA) as competitive advantages

5. Infrastructure Limitations

- If facilities are outdated or capacity is constrained, it can be hard to market effectively
- **Solution**: Focus on planned upgrades, partnerships or temporary solutions like pop-up warehouses.

6. Data and Performance Transparency

- Lack of real-time data or performance metrics can make it hard to prove value.
- **Solution**: Invest in cargo community systems or dashboards to share KPIs like dwell time, throughput and reliability

7. Seasonal and Economic Volatility

- Cargo volumes fluctuate due to global trade trends, fuel prices and geopolitical events

Back to Table of Contents

- **Solution**: Diversify cargo types and build resilience through flexible service offerings

8. Limited Marketing Budgets

- Cargo marketing often receives less money compared to passenger services.
- **Solution**: Leverage partnerships (e.g., with chambers of commerce or trade associations) and focus on high-ROI channels like digital and direct outreach.

Current State Marketing Activities and Examples for Air Cargo Airports

As the industry evolves, airports employ a wider range of marketing activities to promote air cargo services:

- **Cargo Expositions & Conferences**: Participation as exhibitors, speakers, or sponsors at industry events increases awareness and engagement. Staff review event objectives to maximize exposure.
- **Digital Marketing:** Airports now leverage social media platforms (LinkedIn, Facebook, X), search engine optimized (SEO) websites and pay-per-click ads to reach targeted stakeholders worldwide. For example, Schiphol Airport (AMS) promotes its cargo connectivity through regular LinkedIn updates and online webinars.
- **Content Marketing:** Publishing case studies, articles and video testimonials highlighting successful logistics operations helps build credibility. Memphis International Airport (MEM) shares stories on how its facilities support e-commerce giants like FedEx.
- **Virtual Events and Webinars:** Digital forums provide opportunities to showcase new infrastructure, sustainability initiatives, or technology upgrades to potential partners and customers globally.
- **Collaborative Initiatives:** Joint campaigns with airlines, logistics associations, and chambers of commerce help expand reach. For instance, Frankfurt Airport (FRA) partners with local freight associations for trade missions and educational workshops.
- **Data-driven Campaigns:** Utilizing market analytics and customer relationship management (CRM) tools, airports tailor their outreach strategies based on cargo trends and client feedback.
- **Sustainability and Innovation Promotion:** Highlighting eco-friendly technologies, digital tracking systems, and green logistics practices draws interest from socially responsible shippers.

6. Marketing Plan Implementation - Awareness

During the initial phase, the marketing plan should focus on promoting the benefits of utilizing the airport by increasing awareness among cargo stakeholders. This may be accomplished through targeted initiatives designed to engage air carriers and air freight forwarder decision makers at local, regional and headquarters levels. Such programs typically consist of cooperative or informational presentations that emphasize the airport's competitive advantages in terms of services and facilities. Recognizing the factors that influence shippers' routing choices, some airports stress their strategic location and extensive international and domestic air service connections. Others underscore proximity to a substantial manufacturing base, supported by a robust road feeder network and comprehensive interstate highway system. The presence of modern, efficient and cost-effective cargo facilities continues to serve as a significant advantage when demonstrating the airport's attractiveness and encouraging additional air service or forwarder consolidations. Importantly, the development of these facilities should be guided by a strategic plan that accommodates future expansion and integrates essential ancillary and supporting services.

For example, Schiphol Airport (AMS) in Amsterdam regularly hosts logistics summits and collaborates with key shipping companies to highlight its direct access to European markets and advanced cargo terminals. Similarly, Memphis International Airport (MEM), home to FedEx Express' global hub, uses targeted campaigns showcasing its overnight delivery capabilities and state-of-the-art sorting technology to attract new freight clients. In Singapore, Changi Airport (SIN) leverages its proximity to manufacturing zones and superior connectivity by offering incentives and digital solutions to freight forwarders, boosting its reputation as a Southeast Asian logistics center.

Key Marketing Channels for Airport Cargo Promotion:

- Industry-focused conferences and trade shows

Back to Table of Contents

- Collaborations with major logistics and shipping organizations
- Strategic digital outreach, including social media marketing and webinars
- Targeted email marketing campaigns aimed at air carrier and freight forwarder executives
- Participation in sector-specific business forums and networking events
- Direct engagement through personalized presentations and facility tours

7. Marketing Plan – Targeting

As the cargo marketing plan matures, a more advanced approach involves leveraging current digital and data-driven marketing strategies to engage specific carriers and forwarders. Today, airports and airlines use analytics to identify market opportunities, tracking air cargo trends and customer behaviors using tools like CRM platforms and AI-powered data dashboards. Social media campaigns, targeted digital ads, and webinars are used to directly reach logistics decision-makers, while personalized e-newsletters provide tailored updates on airport offerings.

For example, Hong Kong International Airport (HKG) utilizes real-time data sharing and digital freight platforms to attract forwarders by showcasing streamlined customs processing and cargo visibility. Miami International Airport (MIA) runs digital campaigns featuring video tours of its new pharma and perishables centers, highlighting certifications and temperature-controlled facilities to target industry groups on LinkedIn and in sector newsletters.

In parallel, airports now partner with regional economic development agencies to co-host virtual trade forums and create interactive online reports for prospective air carriers. These digital presentations, often leveraging augmented reality or virtual site tours, allow airline executives to explore cargo facilities remotely and examine operational benefits in detail.

For instance, Frankfurt Airport's (FRA) online cargo portal enables prospective clients to simulate shipment routing and cost analysis, while Singapore Changi Airport's (SIN) innovation hub hosts live-streamed showcases of digital logistics solutions.

Armed with these contemporary marketing tools and industry partnerships, airports can present compelling, data-backed business cases to airline and forwarder senior management. In preparing such presentations, collaboration with local government and economic agencies brings further credibility and insight, aligning regional development priorities with air cargo growth potential in today's competitive environment.

- Utilizing digital outreach through targeted social media campaigns, webinars and personalized e-newsletters to engage logistics decision-makers
- Hosting virtual trade forums and interactive online reports, including virtual site tours and live-streamed showcases of airport facilities and innovations
- Partnering with regional economic development agencies and industry groups to co-host sector-specific business events and digital presentations for prospective air carriers and forwarders

8. Conclusion

The dynamic evolution of air cargo marketing reflects both the complexities and possibilities of the modern logistics landscape. By embracing digital innovations such as real-time analytics, AI-powered dashboards, virtual site tours and interactive online reports, airports can connect with carriers, forwarders, and logistics decision-makers in unprecedented ways. These strategies not only highlight operational advantages and specialized facilities but also foster greater transparency and engagement through data-driven storytelling.

Collaboration lies at the heart of this new approach. Strategic partnerships with regional economic development agencies, industry groups, and government bodies amplify the credibility and reach of marketing efforts, ensuring that airport offerings are closely aligned with broader economic aspirations and sector trends. The integration of personalized digital outreach, sector-specific events and immersive experiences empowers airports to present compelling, evidence-based business cases to potential clients and partners, setting the stage for sustainable growth.

Success in air cargo marketing today rests on the ability to combine technological innovation with

Back to Table of Contents

collaborative stakeholder engagement, delivering targeted messages that resonate with the unique needs of each audience. As competition intensifies, airports that leverage these advanced tools and relationships will be best positioned to capture emerging opportunities, drive investment, and remain at the forefront of the global air cargo industry.

Back to Table of Contents

Chapter 3

Demand Forecasting Techniques

Back to Table of Contents

1. Introduction to Forecasting

Cargo forecasts are important to airports for many reasons including master planning and budgeting. Airports that accurately forecast their future traffic will better anticipate the needs of their customers and thus will be in a better position to develop to their full potential. This chapter provides insight into how to best plan for increased cargo activity.

The forecast prepared for a master plan or similar study should represent market-driven demand for air cargo service. To the extent possible demand forecasts should be unconstrained and as such not take facility constraints or other outside limiting factors into consideration. In other words, for purposes of estimating future demand, forecasts should assume facilities can be provided to meet demand. After determining what facilities are needed to accommodate the forecast aviation activity, alternatives can be identified and evaluated to provide any physical improvements.

Forecasts provide critical input for airport management and planning. Cargo forecasting is not just a theoretical exercise, it must consider underlying market forces based on market assessments and economic theory, as well as an airport's physical capabilities and constraints. Every airport is unique and while every cargo operation has some common elements, the translation from best practices to planning metrics will require a careful review of current and past activities.

It is important to remember that air cargo is a high-volume, low margin business that is driven by time, service and cost control. The physical planning extends beyond the parameters of the on-airport buildings to a wide range of business and regulatory interests both on- and off-airport.

Forecasting is an inherently uncertain activity simply because experience can be only a hint about future performance. Even the most sophisticated forecasters find that the actual results are often higher or lower than their predictions. The purpose of this guide is to describe techniques for forecasting air cargo activity for individual airports that can help define and minimize the range of uncertainty or "forecast error."

The best source of customized inputs to a forecast derives from a detailed market assessment. Carriers, their business partners, and all the supporting entities in the air cargo community (including federal agencies) can provide meaningful input to ensure that the forecast is anchored and adds clarity to the planning requirements.

Although forecasting is a challenging task, the production of more dependable traffic forecasts can be guided by a set of principles that have been judged to be effective. These principles of forecasting are:

- It is essential to understand the issues and events driving the forecasts and to communicate with users regarding the nature of the forecasts and their application
- Sound judgment is always an integral part of the forecasting process; impartiality should be maintained through the process
- Use the most reliable and current data: A correct and solid traffic base is essential. If not available, different data sources should be consulted to establish the best possible estimates
- Use the most appropriate forecasting methodology and technique. Different traffic component forecasts require different forecasting technique(s) due to data availability and completeness as well as the forecast requirements such as the level of details
- Consistent assumptions should be applied through the forecasting process, both for input variables and forecast adjustments, to ensure internal and external consistency
- Uncertainties surrounding the forecasts should be identified and dealt with, not ignored

Forecasting is as much about common sense as it is about math. You cannot forecast effectively without using your judgment. Even the simplest trend analysis (e.g., traffic grew by 5% last year, so the forecast calls for 5% growth this year) entails a judgment about whether it is reasonable to assume that past performance will be repeated. It is thus beneficial to compare whatever the calculated forecast is to the range of growth as demonstrated from these historical records. On the other hand, complex econometric models with dozens of independent variables extrapolate historical supply-demand relationships to forecast future activity. The challenge is that the world keeps changing, often faster than the historical numbers can keep up. Some key data points for consideration in assumptions should include key drivers of cargo volume growth such as economic growth, manufacturing and consumer sentiment, international trade growth, and retail sales.

Back to Table of Contents

On the supply and cost side, assumptions could incorporate fuel costs (e.g., crude-oil and jet-fuel prices), trade barriers (e.g., tariffs, customs duties, and potential changes to the U.S. de minimis threshold), as well as the relative cost of alternative transport modes (e.g., marine freight). At airports with significant exposure to international trade, it may also be useful to validate the projected air cargo growth against the forecasted growth of other modes.

The forecaster should also consider the use of the Planning Activity Level (PAL) concept. This approach reflects that the need for any necessary improvements will not be driven by a set point in time but rather by the arrival of future demand levels. While a master plan forecast might tie forecast demand levels to specific years for the purpose of providing context, forecasts are rarely able to predict exactly when activity levels will be reached. Forecasts are most useful in predicting future trends. The actual realization of predicted activity levels will likely differ from the forecast in terms of what year that activity occurs. The PALs represent activity-based milestones that can be used to make future expansion and development decisions, focusing on specific volumes of activity that trigger the expansion requirement, rather than the timing identified in the forecast. The FAA's guidance on master plans supports the concept of PALs, stating "...planners should identify what demand levels will trigger the need for expansion or improvement of a specific facility. In this way, the sponsor can monitor the growth trends and expand the airport as demand warrants".[1]

Three forecast scenarios are developed to provide a range of potential future activity levels. The baseline forecast represents a continuation of the airport's current role in the region and in the national transportation system. The baseline forecast represents the most likely scenario and will be used for future planning. An alternative scenario(s) can be used as a sensitivity analysis to assess the ability of the airport to respond to optimistic and pessimistic demand factors that depart from the baseline forecast. We have had several shocks over the last few decades: the global financial crisis, the 9/11 terrorist attacks and most notably the COVID-19 Pandemic. While these substantial shocks to demand are hard to quantify, it does bear the importance that these do occur and that it is important to be prepared for these significant downside scenarios. Additional case-specific scenarios could be introduced to refine the analysis. Reversals in trade-liberalization trends in the last decade, analysts can vary a key trading partner's average tariff rate, while holding other variables constant, to assess the sensitivity of projected air-cargo volumes to changes in trade barriers.

The following sections will provide an understanding and familiarity about the need for air cargo forecasting, the elements that are incorporated, data sources, and forecasting techniques and models. Periodic updates of the forecast ensure that the planning recommendations remain consistent with the characteristics of the actual activity and reasonable expectations of future activity levels.

2. Importance of Air Cargo Forecasting

While it is sometimes difficult to predict an exact activity level for a specific time in the future, properly preparing a forecast is a necessity in today's business environment. Traffic forecasts are important in understanding an airport's demand growth, assessing market risk, and predicting financial gains/losses to develop management strategy. Often, forecasting is mandated in master plans to secure funding for future capital improvement projects, particularly under federal grants and bond issuances. Airports that accurately forecast their future traffic will better anticipate the needs of their customers and will be in a better position to develop to their full potential.

2.1 Market Demand

Since 2000, the air-cargo market has weathered a series of shocks. The early-2000s tech-bust recession and the 9/11 terrorist attacks triggered an immediate contraction, while the 2008-2009 Great Recession once again reduced global air-cargo volumes. The COVID-19 pandemic was even more disruptive: grounded wide-body fleets erased passenger-belly capacity, forcing a shift to dedicated freighters and ad-hoc "Preighters."[2] Critical impacts included an increased use of trucks, an escalation of insurance costs, consolidation among smaller firms, failure of many small cargo airlines and smaller support firms, higher security costs, longer processing time because of security and increased available freighter capacity which drove down rates.

Learning outcomes from the pandemic included the vulnerability of supply chains, the need to diversify

1 FAA Advisory Circular 150/5070-6B, *Airport Master Plans*, page 48.

2 Semanik, M. (2021) Preighters: *How Airlines Pivoted Operations in the Face of a Global Pandemic.* Executive Briefings on Trade. Washington, DC: U.S. International Trade Commission. Available at: https://www.usitc.gov/publications/332/executive_briefings/ebot_preighters-how_airlines_pivoted_operations_in_the_face_of_a_global_pandemic.pdf (Accessed: 10 June 2025).

Back to Table of Contents

trade partners and the importance of air cargo when other modes collapse. In any case, air cargo has proved very resilient, and most airports recovered back to 2019 cargo volumes by 2023. The continued growth of ecommerce and the emergence of new players such as Temu and Shein on a global scale contributed in large part to this recovery. However, escalating trade tensions and broader protectionist measures, particularly between China and the United States, now pose a growing headwind for e-commerce-led air-cargo expansion.

While China remains as the cargo demand giant for many other countries, emerging trade patterns in recent decades (e.g., the Middle East, SE Asia and Latin America) present new opportunities. Although airports will likely continue marketing themselves for further expansion in Asia, forecasts could also consider and highlight the opportunities in emerging markets. As historical data may be limited, demand could be estimated through simulations or based on analysis of comparable airports that already operate mature routes in those markets.

Figure 1 – World Airport Rankings by Freight and Mail Metric Tonnage

CARGO*						
2024	2023	2019	AIRPORT	2024	% CHANGE VS 2023	% CHANGE VS 2019
1	1	1	HONG KONG, HONG KONG SAR (HKG)	4 938 211	14.1	2.7
2	3	3	SHANGHAI, CHINA (PVG)	3 778 331	9.8	4.0
3	2	2	MEMPHIS, USA (MEM)	3 754 236	-3.3	-13.2
4	4	6	ANCHORAGE, USA (ANC**)	3 699 284	9.4	34.7
5	6	4	LOUISVILLE, USA (SDF)	3 152 969	15.6	13.0
6	5	5	INCHEON, KOREA (ICN)	2 946 902	7.4	6.6
7	7	12	MIAMI, USA (MIA)	2 753 450	9.0	31.6
8	8	8	DOHA, QATAR (DOH)	2 616 849	11.1	18.1
9	11	17	GUANGZHOU, CHINA (CAN)	2 373 727	16.9	23.6
10	10	9	TAIPEI, TAIWAN (TPE)	2 270 974	7.5	4.1

* CARGO: LOADED AND UNLOADED FREIGHT AND MAIL IN METRIC TONNES **INCLUDES TRANSIT FREIGHT

Source: ACI World

Source: ACI World
** Cargo: Loaded and unloaded freight and mail in metric tonnes*
*** Includes transit freight*

Evolving carrier route structures and increased passenger aircraft capacity also add to the demand dynamics. Several carriers have shifted from dedicated freighters to passenger aircraft. Freight forwarders have also taken advantage of this shift as they capitalize on underutilized belly capacity. The diversion of international passenger routes to various secondary airports and improved ground infrastructures will continue to pull cargo volume away from mature gateways. One positive aspect of the pandemic is that both airports and airlines have realized the financial contribution of air cargo and as such some traditional passenger only carriers like Air Canada, have also acquired all-cargo aircraft.

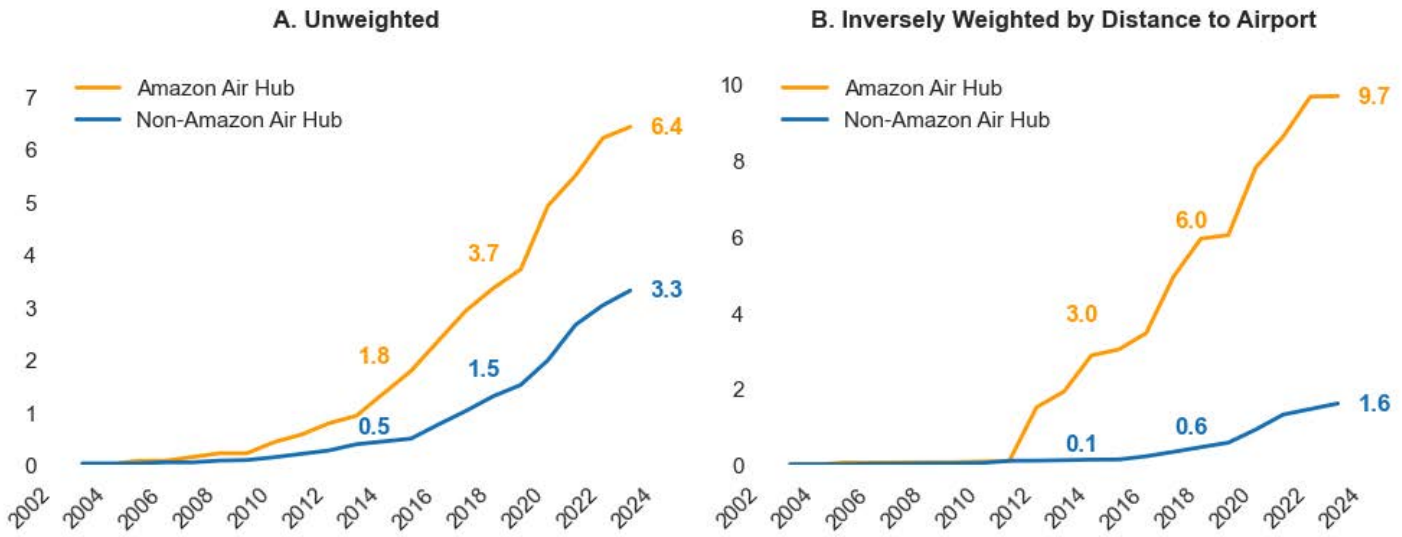
Despite the introduction of new international routes from various airports, not all airports will receive air cargo at higher volumes. Domestically, the two major integrators (FedEx Express and UPS) will continue to drive cargo routing patterns as they continue to concentrate freight at established cargo hubs and major international gateways. While some airports have benefitted as regional hubs in the integrators' networks in the past, other airports will continue to serve local metropolitan areas, often as drop centers, connecting to air services at other airports.

Since the mid-2010s, when Amazon began its own operations, several smaller, less congested "non-traditional" cargo airports have attracted non-integrators, notably Amazon's operations and sub-contracted operators and airlines. Their proximity to consumer markets and ample space for warehouses enable the rapid distribution demanded by e-commerce has become a real advantage. As shown in the figure below,

Back to Table of Contents

the average number of fulfillment centers near airports that eventually became Amazon Air hubs has increased at a significantly faster pace than around airports that did not become hubs. Notable examples include Lehigh Valley International Airport (ABE) and Baltimore/Washington International Thurgood Marshall Airport (BWI). Growth at these locations, accelerated by the pandemic, has enabled Amazon to act more like an integrator and disrupt the integrator space as it begins to own and lease cargo aircraft for the distribution of both its own products and for third-party operators.[3]

Figure 2 – Average Number of Amazon Fulfillment Centers



Sources: MVPWL International and Consultant Analysis.
Note: The figure displays the average number of fulfillment centers within a 45-minute trucking distance of an airport based on its Amazon Air hub status as of 2023. Panel A reports simple unweighted averages, while Panel B shows averages inversely weighted by each facility's proximity to the airport.

In stimulating local air cargo activity, airports geographically positioned for freight have developed trucking drop centers located near major highways to efficiently pull air traffic away from gateway airports. Marketing these routings as cheaper alternatives for shipping freight, airports have provided drop centers near major gateways for freight to be transported to the alternative airport at no additional cost to freight forwarders. While these drop center facilities continue to expand at alternative airports, volume that has been diverted remains limited.

While airports continue to develop, redevelop, and expand to adapt to anticipated air cargo growth, the forecaster must not only understand the evolving changes and trends in the industry but also anticipate the impact of emerging technologies to accurately assess potential capacity and infrastructure needs.

2.2 Facility and Infrastructure Demand

The global economic slowdown resulted in cargo volume dropping at most airports, making facilities demand forecasting much more difficult. Adding to the complexities are modal shifts, airport accessibility regulatory and security compliance issues, fuel pricing, environmental issues, changing aircraft configurations and shifts in supply chain business strategies.

Air cargo growth patterns often combine one or more countervailing trends. For example, international freighter services have continued to concentrate at the major U.S. gateways for efficiency and cost purposes. At the same time, shifts in business and supply chain locations have created a need for new facilities at secondary gateways. A forecast plays a fundamental part in emphasizing demand growth; it also needs to align demand with the infrastructure and facility requirements. Within these requirements are desires for newly built air cargo facilities, easier airport access, warehousing, sorting and storage space, smoother customs policies, secure airside access and shorter taxi time.

While some airports continue to market vacant facilities to new cargo tenants, other airports have converted

3 Kulisch, E. (2024) "Amazon airline sells excess cargo capacity to third-party shippers," *FreightWaves*. Available at: https://www.freightwaves.com/news/amazon-airline-sells-excess-cargo-capacity-to-third-party-shippers (Accessed: 10 June 2025).

Back to Table of Contents

such excess facilities to alternative uses. In some cases, logistics providers have taken leases on such vacancies and converted them into office and trucking distribution facilities.

As costs continue to dictate business directions, many forwarders have decided to relocate their distribution facilities to off-airport locations. Developers can own off-airport property rather than leasing from the airport, thus allowing for long-term financing and residual property value. Additionally, off-airport property construction costs are often cheaper and the facilities more quickly developed. The less strict security requirements of off-airport property also provide another key benefit to off-airport real estate. Under the Transportation Security Administration's (TSA) Certified Cargo Screening Program (CCSP), the 100 percent screening requirement can be met by allowing off-airport facilities to certify and screen cargo.

The elements of doing business are constantly changing and business decisions will evolve to achieve optimal financial efficiency and influence facility development. It is key that forecasts reflect industry changes and allow airports to adjust facility development, modernization, and lease agreements to demand, and thereby become successful. It will enable management to change operations at the appropriate time to attain the greatest benefits and prevent losses.

3. Elements of Air Cargo Forecasting

Future levels of air cargo traffic and related activity for a particular airport (or system of airports) will be affected by various demand and supply elements as they apply for a specified forecast period. An air cargo forecast requires some understanding of how these factors determined activity levels in the past and how changes in those factors may affect the future. Trend forecasts implicitly assume that past trends in demand and supply elements will continue, while econometric forecasting attempts to explicitly measure the influence of specific factors. It is important that a forecaster be cognizant of how demand and supply characteristics produce an aggregate level of cargo and aircraft traffic.

Air cargo markets combine cargo flow demand with the available air cargo service supply sector to create airport activity levels. In simple terms, cargo flow demand for a particular airport is an aggregation of all the various shipments that transit that airport, each with a unique timing, origin and destination points, commodity type, packaging, shipment size and service requirements (e.g., desired transit time or perishability). Air cargo services encompass the available routing options for those shipments and typically should include those of competing airports and modes of transportation. Air cargo services include airport-to-airport transportation as well as supporting ground services (e.g., trucking, handling and storage) and can be compared in terms of cost, transit time and level of service. The air cargo supply sector also includes on- and off-airport facilities and infrastructure (e.g., runways and access roads).

This section will describe the key elements that can be used to describe and measure cargo demand, service supply and the resulting cargo activity.

3.1 Air Cargo Demand

The demand for air cargo services is driven by the highly diverse needs of shippers and consignees. Shipments are typically high-value and time-critical, ranging from the overnight documents and donor organs to the managed distribution of components and products for multi-national high-tech manufacturers.

Some key characteristics of air cargo demand include:

Origin/Destination

Most air shipments do not originate or terminate at an airport, so industrial and demographic location patterns drive flow patterns. The origin and destination of a shipment determine the range and cost of routing and service options that may be available. It is also important to know that any changes in the economic footprint of the airport that may have a beneficial or detrimental impact on air cargo eligible commodities. For example, is the local catchment area seeing a new pharmaceutical manufacturing facility that would benefit air cargo export demand?

Commodity

Commodity type affects both the desirability of and requirements for air services. Key characteristics include perishability (time or physical), value, weight, and physical dimensions. There are thousands of distinct commodities that move in air trade markets, each with distinct shipment characteristics. Since air typically

Back to Table of Contents

costs about 10-20 times more by air than ocean the underlying commodity must have sufficient value to justify the more costly mode of carriage.

Desired Level of Service

The optimal level of air cargo service typically involves a trade-off between the cost and the quality of service as determined by transit time, reliability and security (including maintaining perishable goods), often compared to the same characteristics for available surface options.

Shipment size

For the most part, air shipments are small and typically must be consolidated into pallets or containers for handling to and from the aircraft. Larger sized shipments may require special handling or aircraft type but are also more susceptible to diversion to another mode of transport.

Cargo demand for an airport is primarily determined by the location and volume of air commodity production, consumption and/or distribution[4] within that airport's catchment area (or market hinterland). The demand for any airport is also affected by the location and competitiveness of alternative airports or modes of transport. The domestic and international catchment areas for an airport differ as follows:

U.S. Domestic

The integrated carriers (FedEx Express and UPS in the U.S.) dominate the handling of domestic air cargo shipments and therefore the domestic catchment area is determined by the ability to meet next-day morning delivery schedules for those carriers. The size and scope for any airport's catchment area is primarily based on the location of alternative airports and relative drive times to the primary pickup/delivery areas. Amazon, which has expanded its U.S. warehousing space more than five-fold since 2017, is now becoming an increasingly domestic player.

International

North American international air trade is dominated by a few large gateway airports that draw cargo from large regional markets via both truck and air connecting services. Primary gateways also attract cargo based on their proximately to world regions. For example, Los Angeles International Airport (LAX) and Vancouver International Airport (YVR) will attract cargo bound for Asia from the U.S. East Coast, and John F. Kennedy International Airport (JFK) and Toronto Pearson International Airport (YYZ) will similarly handle Europe-bound traffic from the West Coast. There are advantages to direct service to smaller gateway airports, particularly for traffic from a more constrained primary area as defined by same day pickup/delivery time by truck (typically 50 to 100 miles from the airport, depending on the location of other gateway airports).

Within an airport's catchment area, the key demand factors that would affect cargo forecasts are general economic trends as well as specific regional demographic and industrial trends including:

Regional Demographics

The demand for inbound air shipments is affected by population and income levels (as is outbound demand for shipments generated by individuals). Shifting consumer preferences and widespread internet penetration have fueled the rapid growth of e-commerce, which in turn has led to increased air-cargo traffic at non-traditional hubs.

Regional Employment and Production

Demand for outbound air services is determined by air commodity production volumes within a region, which also affects inbound demand to the extent that machinery, parts and components are shipped in by air in support of that production.

Regional Industrial Location Patterns

Industries make location and expansion decisions based on a variety of cost and efficiency factors. Accordingly, future growth in particular air cargo movements may depend on non-transport factors that drive those decisions. Forecasters should evaluate regional industrial concentration, which can determine whether an airport flourishes or stagnates because industry clusters translate directly into predictable freight

4 Some outbound items may be produced outside of an airport's catchment area and trucked to a distribution center where the air shipment would originate with a similar pattern for inbound commodities.

Back to Table of Contents

flows. A dense concentration of high-value, time-sensitive manufacturers (e.g., pharmaceuticals, electronics, advanced machinery) generate steady outbound shipments of finished goods and inbound flows of components, attracting integrators, forwarders and dedicated freighter services. Firms within such clusters also benefit from agglomeration economies: shared suppliers, specialized labor and logistics infrastructure reinforce one another, prompting further investment and route development.

Conversely, if an industry base erodes or is too diversified into low-value commodities, freight volumes fragment or shift to cheaper surface modes, reducing the justification for frequent air service. Without a critical mass of shippers, carriers redeploy capacity to stronger markets and the airport risks a downward spiral of fewer flights, higher unit costs and lost competitiveness.

Industrial concentration is often measured with a location quotient (LQ), which is the ratio of an industry's share of local employment to its share of national employment.[5] For instance, An LQ of 1.25 indicates the industry is 25 percent more concentrated locally than nationwide, signaling a meaningful cluster.

Regional Warehousing and Storage

Rapid e-commerce expansion has shifted cargo growth to non-traditional hubs, where inbound and outbound shipment demand depends on whether nearby facilities operate as sort centers or middle-mile gateways. ABE illustrates this trend: after Amazon launched service in 2015, the airport's cargo throughput climbed to more than five times its pre-Amazon level. At these hubs the mix of inbound and outbound lift hinges on facility role: sort centers break down and repalletize parcels for final delivery, producing mainly outbound flows, whereas middle-mile gateways consolidate line-haul flights and draw substantial inbound tonnage.

Shifts in Commodity Demand

Economic, industrial and demographic factors affecting the destination markets that trade with a particular regional market will also affect future air cargo growth. Some things to consider are the continued growth of ecommerce and potential repatriation of manufacturing activity to North America from Asia and other regions that produce air cargo exports.

Shifts in Distribution Practices and Patterns

The importance of logistics in both manufacturing and final product distribution drives intermediate demand for air and other cargo transportation. The development of regional distribution centers serving large geographical areas has created new air cargo for some airports based not on local demand, but on the efficiency of transferring cargo to satisfy other regions' demands.

The impact of demand on air cargo forecasts for an airport can typically be measured using general economic forecasts in concert with some consideration of trends in commodity and origin/destination mix. But it is also important to consider some of the other factors, especially for markets that are highly dependent on a single industry that may relocate, a commodity that may lose popularity or suffer environmental problems, or a foreign economy that may experience extreme variations. With increased economic uncertainty, it is also useful to consider scenario analysis that incorporates multiple possible future scenarios, including varying levels of trade policies, climate risks, and geopolitical outcomes.

3.2 Air Cargo Services and Other Supply Factors

Air cargo service providers include airlines, airports and support service firms. Airlines provide the air transport segment of air shipments, but they may also provide ground handling or pickup/delivery services. Air carriers are primarily categorized as either (1) direct airport-to-airport carriers that mostly concentrate on air transport (including both passenger and freighter aircraft operators), or (2) integrated all-cargo carriers who maintain single entity responsibility for shipments on a door-to-door basis (and therefore supply most of the ground support services). Airports facilitate the transfer and handling of air cargo by providing infrastructure, facilities and support services. Other firms provide services to the airline or the shipper/consignee including:

- Freight forwarders act as agents for the shipper or consignee in managing, providing or securing air, ground, and other handling services

5 Bureau of Economic Analysis (2008). *What are Location Quotients?* Available at https://www.bea.gov/help/faq/478. (Accessed: 10 June 2025).

Back to Table of Contents

- Customs brokers are primarily responsible for marshaling inbound international shipments through local customs and inspection requirements and may also handle ground services at the destination airport
- Trucking firms assist in the transportation between the airport and origin/destination points when not directly provided by the airline or forwarder
- Specialized service firms including warehousing, airport ground handlers, and third-party logistics (3PL) or distribution firms

Some of the service factors that will influence cargo forecasting include:

- Unlike other modes, air cargo flight capacity is significantly affected by passenger demand and service patterns, particularly for international markets. Future shifts and growth in passenger services will drive cargo routing patterns.
- The emergence of the U.S. integrated carriers has resulted in a significant decline in the need for general all-cargo and passenger capacity in the U.S. domestic market and affected the express segment of international cargo markets. Future changes in how integrated carriers structure and operate their networks will greatly affect routing patterns, particularly for their hub and gateway airports
- General all-cargo freighter service typically provides flight capacity on routes where passenger flights cannot satisfy demand either in terms of capacity or capabilities (e.g., oversized shipments). While limited in the U.S. domestic market, non-integrated freighters continue to have a strong role in the international market and shifts in the use and routing of freighters greatly affects traffic levels particularly for smaller secondary gateways. Freighter capacity may also be the first to be reduced in a downturn, adversely affecting certain airports.
- The pattern of air carrier routings is affected by the range and payload characteristics of both passenger and freighter aircraft and future fleet trends should be considered in forecasts.
- Another aircraft-related factor is the level of future fuel prices that will not only affect operating costs but will drive many fleet decisions. Fuel price increases disproportionately affect air relative to other modes often leading to increased rates and mode shifts.
- Increased post-9/11 security has affected the air cargo market significantly, based on the reduced ability to handle cargo on passenger flights and time/cost impacts from increased screening and security review. This is particularly true in the domestic market where trucking services have significantly less restrictions.
- Air cargo routing patterns are not driven entirely by cost and time factors as experienced by the shipper, but also depend on internal efficiency strategies for the airline and forwarder industries. The concentration of international air cargo at a limited number of gateways is partially caused by airlines wanting to use common airports for their passenger and freighter flights or by efficiencies related to airline partnerships. Forwarders also have a major influence on routing decisions as their gateway systems concentrate international traffic at a limited number of airports based on internal efficiency and profitability.
- International regulation may also affect cargo service and routing patterns as a limited number of markets are still controlled by bilateral agreements that limit carrier entry and routes. The availability of federal agencies for clearance may also impact decisions on the routing of international freight.
- Shifts in trade barriers and policies have introduced additional complexity. In response to new tariffs, some international e-commerce retailers are pivoting away from direct drop shipping to establishing a U.S. warehouse network.[6]
- On the environmental side, the key issues are noise and emissions. Future noise and emissions restrictions could affect the ability to use certain airports or the cost of operating all cargo fleets, many of which are heavily populated with the older aircraft targeted by the regulations.

In terms of cargo forecasting, the most important supply consideration is whether existing patterns and trends can be expected to continue, or whether some of the key supply factors should be incorporated into the forecast process.

6 Gilchrist, K. (2025) 'Shein and Temu see U.S. demand plunge on "de minimis" trade loophole closure', *CNBC*. Available at: https://www.cnbc.com/2025/06/05/shein-temu-see-us-demand-plunge-on-de-minimis-trade-loophole-closure.html (Accessed: 11 June 2025).

Back to Table of Contents

3.3 Airport Traffic and Other Activity

The airport traffic and activity levels that are measured and forecast are based on the interaction between air cargo demand and supply patterns, the details of which are not easily discerned from airport-level statistics. Traffic patterns reflect the underlying demand for shipping between various geographic regions, the type of commodities involved and the way individual providers tailor their services to meet demand.

In terms of forecasting, the key activity measures include:

- Shipment weight and value
- Number and capacity of aircraft operations by category (passenger, all-cargo, integrator), type (passenger, freighter) or aircraft size category
- On- and off-airport truck activity
- On- and off-airport facility/infrastructure utilization.

For short-term forecasts or those for relatively stable markets, it may be possible to forecast one of those statistics (e.g., traffic tons) and apply ratios for any others that are required. However, such simple assumptions may obscure fundamental shifts in the demand and supply sectors and lead to inaccurate or unreasonable forecasts.

4. Air Cargo Data Sources

This section discusses the various sources of data that can be useful in forecasting cargo demand.

4.1 General Sources for Traffic and Activity

Data sources include:

- Individual airport statistics
- Airline industry sources (Airports Council International-North America (ACI-NA), International Air Transport Association (IATA) and Airlines for America [A4A; formerly known as Air Transport Association of America])
- U.S. Department of Transportation (DOT) aviation statistics (Form 41/T-100)
- Flight schedule data (Official Airline Guide [OAG] and Cirium [Diio])
- There are also third-party data providers such as: Wiser Trade (trade data), Cargo IS (IATA clearinghouse data) and World ACD (airline reported data)

The level of detail available from airports varies but typically includes carrier-level totals for enplaned and deplaned tonnage and the number of flights. Airports collect this information directly from the airlines so there may be additional information available internally.

ACI-NA collects domestic and international traffic statistics (freight and mail) from member airports that are roughly equivalent to statistics produced by individual airports. The ACI-NA data does not include any details on commodities, airlines or routings. IATA also collects international freight statistics from its member airlines that are available in aggregate form by region and airline. Detailed international data collected through the IATA billing system (CASS) is available to submitting airlines and forwarders only.

The U.S. DOT T-100 statistics provide airport-to-airport traffic statistics by airline, service type (cargo/passenger and scheduled/non-scheduled) and aircraft type (all-cargo, passenger, and combi). The data covers both U.S. and foreign carriers and includes flights, capacity, and freight and mail weight by direction. The data is available in two primary sets. The segment data covers all onboard traffic moving on non-stop flights between two airports and includes details on service and aircraft type (including capacity and flights). The market data covers all on-flight traffic between two airports based on the airports where the cargo

Back to Table of Contents

is enplaned and deplaned.[7] The release of international data occurs approximately six months after the measured period (with U.S. domestic data released after three months). There is no similar data set in the Canadian market as the transparency of data in Canada has not matured to the extent that it has in the U.S., however Stats Canada does compile air cargo by airport albeit on a lagged basis by several years.

Current and historical scheduled flight data can be used to profile cargo and passenger flight schedules by carrier, aircraft type/capacity and origin/destination market, but often does not include the integrated carriers and may exclude some international cargo flights as well. The integrator historically but not planned activities could be captured by Flight Aware and other real time flight activity trackers.

4.2 International Cargo Flow Sources

The primary source of U.S. international air trade data is the U.S. Bureau of the Census commodity series that provides weight and value for air imports and exports (based on mode to/from the point of entry/exit) by commodity (10-digit harmonized schedule with concordances to other codes), foreign country of origin/destination and U.S. Customs District of entry or unlading (for imports) or Customs District of exit (for exports). In recent years, port-level detail (for unlading or exit) has been made available, although there is some suppression to protect the identity of integrated carriers. Wiser Trade provides cleaned international trade data across various country databases such as that for: Canada, the U.S., Mexico, Japan, South Korea and the EU amongst others.

Export data with additional origin detail is available in the U.S. Bureau of the Census state of export series in two primary formats:

- Commodity: State of origin by destination country by commodity (6-digit Harmonized Schedule (HS) or 3-digit North American Industry Classification System (NAICS) code)
- Port of Exit: State of origin by destination country by airport of exit

To the extent that foreign-to-foreign cargo flows are of interest, some countries maintain similar trade statistics (although few with air-specific data) and there are also air-specific traffic statistics (e.g., IATA and Seabury). Another useful tool is World Bank's World Integrated Trade Solution (WITS), which provides not only data on bilateral trade, though not the data is not specific to air cargo, but also tariffs.

4.3 Domestic Cargo Flow Sources

The data available for U.S. domestic traffic is extremely limited, particularly regarding commodity detail and include:

- Commodity Flow Survey (CFS) data – provides some highly aggregated data, commodity and other details that are mostly obscured for air traffic by confidentiality restrictions; distinguishing domestic vs. international is also a problem.
- Transearch/Freight Analysis Framework (FAF): Weight and value by origin/destination region and commodity group are available for Air and truck mode. FAF is derived from the CFS, provides international flow statistics and includes long-term forecasts.

4.4 Other Sources

Other sources include:

Commercial Airline Fleet Databases

Detailed world fleet databases (e.g., ACAS or BACK) provide statistics on individual aircraft's historical patterns of ownership and use. This data source can be used to identify and describe the current fleets of cargo carriers by aircraft type/capacity and then track the historical use of those aircraft in terms of annual block hours.

7 This distinction only affects traffic that moves on a multi-stop flight. For traffic on a flight from A to C that stops at B, the segment data would show the traffic for the A-B and B-C airport pairs, while the market data would register the traffic on the A-C airport pair. Note that the data is collected based on airlines' flight numbering system and a one-stop flight that changes its number at the intermediate stop will show up for two separate market pairings.

Back to Table of Contents

U.S. Carrier Form 41/T-100 U.S. DOT Financial Statistics

U.S. carriers file operating and financial statistics with the U.S. DOT identified by aircraft type and domestic/international use. These statistics can be used to profile aircraft operating costs and profitability at the aggregate market level (U.S. domestic and general world region).

Cargo Forecasts

A review of benchmark industry trends, regional market data, and shipping patterns will increase the reliability of a cargo forecast. Several forecasts including the FAA Terminal Area Forecast, FAA Aerospace Forecast, Boeing Current Market Outlook and the Airbus Global Market Forecast are reasonable forecasts that can be used as benchmark data and are discussed below.

FAA Terminal Area Forecast

The FAA publishes its own forecasts annually for each U.S. airport. The Terminal Area Forecast (TAF) system is the official forecast of aviation activity at FAA facilities. These forecasts are prepared to meet the budget and planning needs of FAA and provide information for use by state and local authorities, the aviation industry, and the public. The TAF includes enplanement and aircraft operations forecasts for: FAA towered airports, federally contracted towered airports, and non-federal towered and non-towered airports. Detailed forecasts are prepared for the major users of the National Aviation System including large air carriers, air taxi/commuters, general aviation and military. The TAF includes forecasts for active airports in the National Plan of Integrated Airport System (NPIAS).

FAA Aerospace Forecast

The FAA Aerospace Forecast can be used as a tool to look at the FAA's overall expected outlook on the air cargo industry and the FAA's projected domestic and international growth in terms of revenue ton miles on a system-wide basis.

International Market Forecasts (Boeing/Airbus/Other)

At a macro level, institutional forecasts such as those made by Boeing and Airbus are helpful in considering international volume growth but should only be applied as a means of comparison to airport-specific forecasts, rather than used as a rote source for growth rates. The Boeing Current Market Outlook and the Airbus Global Market Forecast can also be consulted for their assumptions and freighter fleet growth projections. The use of forecast cargo growth rates and an outlook of future aircraft orders can be used as a metric to better understand the potential growth and prospects of cargo operations in the future. These forecasts include an inherent bias for future aircraft demand.

Regional/National Economic Forecasts

Historically, air cargo activity tracks with gross domestic product (GDP). An example of a dependable national economic forecast would be the Congressional Budget Office's (CBO) Budget and Economic Outlook. A potential downside of relying on CBO's forecasts is that they are only updated semi-annually. For more timely economic outlooks, users could consult Moody's Analytics or IHS Markit, which is used by the FAA to produce their Aerospace Forecast.

Cargo Carriers, Brokers, Freight Forwarders and Shippers

Depending on the scope of the forecast and the nature of the activity at the subject airport, the best source for both historical data and an idea of plans will be the company's handling and transporting the cargo. Carriers, their business partners and all the supporting entities in the air cargo community can provide meaningful input to ensure that the forecast is anchored and adds clarity to the planning requirements. It can also be meaningful to talk to some of the larger air shippers in the airport's catchment area as well to get both a short-term and longer-term view of the magnitude of their air cargo eligible shipments.

Wiser Trade

This is a third-party subscription data set that provides cleaned international trade data which can be broken down on a country pair basis and by exit or entry airport. It has commodity level information broken down by HS code but does not have any carrier or freight forwarder specific data. The frequency of data is monthly and is reported about two months after the actual reporting period.

Back to Table of Contents

IATA Cargo IS

This is a third-party subscription data set sold by IATA which provides clearing house settlement data by month. It has volumes broken down by country and airport pair and can be broken down to the airline and freight forwarder level. There is a high level of commodity information, but it would be considered inferior in this regard compared to trade data. There is limited data and insight into the integrated carriers on their express operations.

World ACD

World ACD provides a third-party subscription data set based on data reported directly from airlines. It also provides country to country and airport to airport data which is also supplemented by yield data which is unique to this platform. Like others, there is limited data for the integrators in their operations but this dataset does provide historical integrator and other airline movements.

5. Forecasting Techniques and Models

Forecasting methods range from applying simple growth rates to market-specific detailed modeling. This chapter demonstrates appropriate techniques for users.

5.1 Collecting and Understanding the Data

Forecasting aviation demand is not an exact science where the same approach can be applied at all airports. Each airport presents its own unique set of variables that need to be considered.

To project aviation demand, many factors need to be analyzed including current aviation industry and cargo trends (particularly those appropriate to the airport), catchment area socio-economic data, historical air service and cargo traffic trends, benchmark data and competing air services at alternate airports.

5.1.1 Current Aviation Industry and Cargo Trends

A review of industry trends, regional market data, and shipping patterns will supplement the forecast. As the airline industry undergoes major changes, the basic ingredients of an airport's successful air cargo operation have remained essentially intact. However, as airports mature, regional growth and evolving dynamics in goods movement may negatively impact the region's ability to meet the needs of the air cargo industry and eventually force operations to shift to alternate facilities or modes. The challenges create opportunities to be explored regarding more efficient utilization of existing airport assets, as well as the development of new facilities and infrastructure, and enable airports to review financing options.

5.1.2 Catchment Area Socio-economic Data

Catchment area is the area and population from which a facility or region attracts business. The catchment area is determined by the level and type of air services offered at an airport relative to competing airports. It is also influenced by connecting road networks.

The intrinsic links between the level of aviation activity and economic growth in the catchment area are well documented. Simply put, growth in population, income, employment, and business activity in the catchment area typically led to increased demand for cargo traffic. For example, an increase in population drives an increase in the consumption of products, many of which are transported by air. As a result, an increase in population can lead to an increase in air cargo demand. The same holds true for personal income and employment. Economic output (gross domestic or regional product) has been found to have a high degree of correlation to air cargo traffic. This is because as economic output grows, the number of raw materials and finished goods that must be transported also increases.

5.1.3 Historical Air Service and Cargo Traffic Trends

Historical data factors show how an airport's traffic has evolved and will serve as the starting point for the development of comprehensive forecasts. A review of recent trends also identifies those factors which have, or in the future might, influence future traffic volumes. It is suggested that at least the same number of years of historical data be used as the time horizon of the forecast. Evaluating a longer historical time frame can make it easier to distinguish true trends from short-term aberrations and enhances the accuracy of the

Back to Table of Contents

projected relationships between independent and dependent variables. The historical analysis of aviation activity is one of the key factors in developing assumptions underlying the forecast. However, the forecast assumptions should also be based on broader industry trends, economic analysis, and review of peer forecasts such as those published by the FAA, Boeing and Airbus.

5.1.4 Benchmark Data

Benchmark data and growth trends for a similar airport(s) can provide a guide for what level of growth an airport can expect in the future. It is important to benchmark to airports with a similar role (cargo hub vs. non-hub vs. international gateway, domestic vs. international cargo, freighter vs. belly cargo) and/or geographical location (West Coast vs. Midwest vs. East Coast). A review of historical growth trends, markets served and aircraft size at benchmark airports can be useful in identifying factors that will influence future growth in cargo volumes.

Benchmarking can be particularly useful when an airport's role in the cargo market is changing. For example, when an airport loses its cargo carrier hub status it can be useful to look at other airports without cargo hubs to see what type of growth trends can be expected. Conversely, if a forecast is considering the establishment of a cargo hub at an airport, the evaluation of historical cargo volumes after the creation of a cargo hub at a benchmark airport can provide invaluable data on potential future cargo demand.

5.1.5 Competing Air Services

To forecast air cargo demand at an airport, it is first important to identify other competing airports that exist within the region and determine an airport's historical market share of air cargo. It is necessary to understand the level of cargo currently being transported through nearby airports, the role of these airports, and whether the competing airports can accommodate future growth. The proximity of an international gateway or cargo hub to an airport can be an influential force in determining the cargo volumes that can be expected at a particular airport. Capacity constraints at a nearby hub can mean opportunities for an airport with excess capacity.

5.2 Benchmarking Analysis

Analysis of the data collected is the next step of the forecasting process. The data collection results should be analyzed to determine whether there are any gaps between the airport's records and those that have been gathered for benchmarking purposes. From this information, strategic planning can be employed to make improvements to the airport's data reporting processes.

If the performance of the selected benchmarks is superior, it is important to understand the need to determine whether there are problem areas, whether the benchmarks used were not the best comparisons and to provide input into subsequent modification and improvement.

This analysis can be conducted within various time frames, depending on whether an airport is looking for short-term or long-term trends. For example, an airport would normally select a short-term time frame if it was considering a new route, and a long-term time frame if considering facility development.

5.3 Common Forecasting Techniques

There are many forecasting techniques ranging from applying simple growth rates to market specific detailed modeling. The most appropriate forecasting methodology is typically determined based on the available data. The most common techniques include a simple growth rate model, time series, and an econometric approach. These models can be specified at the individual airport level, at a multi-airport level, or at a regional/national level. The models can also be combined with a market share forecast.

Each of these techniques has its own set of advantages and drawbacks and they may be used independently or in combination. No one approach is always the best. The following sections demonstrate appropriate forecasting techniques for various uses.

5.3.1 Simple Growth Rate Model

The simple growth rate model does not rely on an analysis of historical data. It applies an externally produced growth rate to a single cargo statistic such as tonnage transported. The growth rate used could come from

Back to Table of Contents

sources such as the FAA Aerospace Forecast or the Boeing/Airbus annual forecast. The simple growth rate model assumes that the broader base of the external forecast growth rate will apply to the subject airport.

5.3.2 Time Series

Time series analysis projects historical trends into the future using time as the primary independent variable. As time series forecasts are one-variable models, they require only the data for the variable to be forecast.

Frequently while forecasting, the forecaster has observations on only a single data series and must develop forecasts without being able to include other explanatory variables. In such a case only the past values of this single variable are available for modeling and forecasting.

In general, time series data can be described by trends, seasonal effects and cyclical effects. The first step in putting together a time series forecast is to analyze a time series of historical data for the specific airport or market to determine the growth trend. The easiest procedure for isolating the trend in a time series is to plot the historical data in graphic form on an x and y axis. The traffic data is plotted on the vertical (y) axis. Time, the independent variable, is plotted on the horizontal (x) axis. It is then possible to draw a curve or trend line which minimizes the total distance of the plotted points. In simple forecasts, it is possible to extend this line into the future to estimate future traffic. Growth rates, positive or negative, can be calculated from the slope of the line. Generally, expressing growth in terms of CAGR (compound average growth rate) is recommended. Growth rates can then be applied to the base year (or last year in the time series to project traffic into the future). Many popular computer software programs, such as Microsoft Excel, automate the process of developing the historical trendline.

The primary drawback to this technique is that it fails to consider how the economic, demographic and industry factors that existed during the historical period are likely to be different in the future.

The time series technique is useful for the following situations:

- When detailed data is not available
- When the financial and technical resources required for a more rigorous forecast are not available
- When the anticipated growth is expected to be relatively stable
- When the operating and economic environment is expected to be relatively stable.
- For short term forecasts (less than 5 years)

5.3.3 Econometric

Econometric analysis is a form of multivariate analysis utilizing the relationship between the dependent variable (i.e., cargo traffic) and a set of independent economic, demographic and operational variables (i.e., price, personal income).

Economic forecasting is used to show how predicted changes in the independent variables would affect future cargo traffic. The following steps are used when developing an econometric forecast:

1. Specify independent variables for testing
2. Data collection
3. Select a statistical model
4. Determine the model's ability to accurately predict historical values
5. Use model to derive forecast traffic values
6. Evaluate results in context of historical traffic patterns
7. Compare with benchmarks (i.e., FAA Aerospace Forecast and TAF)

Specify Independent Variables

Prior to selecting a model, a forecaster must determine what independent variables should be considered in the forecast. Proper independent variables can be selected by determining which factors are likely to have

Back to Table of Contents

the greatest effect on traffic growth. Typically, these variables include:

- Population
- Economic output (gross domestic or regional product)
- Personal income (total or per capita)
- Employment
- Similar statistics for destination markets

Selecting independent variables demands both domain expertise and local perspective. For example, global trade volumes and tariff levels exert more influence on cargo throughput at an international gateway airport than at a domestic facility, whereas the arrival of a major e-commerce or retail operator is likely to have a more direct impact on a domestic airport. Additionally, examine the interrelationships among candidate variables: strong correlations can introduce multicollinearity and erode the reliability of forecast results.[8]

Data Collection

Once the forecaster specifies the independent variables, credible data (historical and forecast) for each of the variables must be collected, including the dependent variable cargo traffic. The data should be collected as a time series. Historical cargo traffic can typically be provided by the airport. Economic data sets, including forecasts, can be obtained from several sources such as the Bureau of Labor Statistics, U.S. Census Bureau, the National Bureau of Economic Research or independent institutions such as Woods & Poole Economics, Moody's Analytics, or IHS Markit.

Select a Statistical Model

Once data for each of the independent and dependent variables is collected, the forecaster must determine which model best describes the relationship between the dependent and independent variables. Typically, one of the following models is used:

$$Linear: Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

$$Multiplicative: log(Y) = log(\beta_0) + \beta_1 log(x_1) + \beta_2 log(x_2)$$

$$Linear\text{ - }Log: Y = log(\beta_0) + \beta_1 log(x_1) + \beta_2 log(x_2)$$

For each model, there is a single set of constant coefficients (β) which provides the best fit of the equation to the data.

Determine Model's Ability to Accurately Predict Historical Values

Once the forecaster determines the model to be used, the forecaster should apply the data to the specified model. It is then possible to determine whether the model is accurately assessing each of the variable's relationship to cargo traffic. This is done by entering the independent variables into the model and determining if the resultant is near the historical dependent values. Should the resultants not reflect the historical values, the forecaster should choose a different model. If no model results in accurate historical results, one or more of the independent variables should be removed from the model. Finally, models should be kept simple. Using fewer variables to capture the main patterns in the data helps avoid overfitting and makes the model more reliable.[9]

Back-Testing and Cross Validation

When sufficient historical observations are available, forecast performance should be evaluated out-of-sample rather than on the data used for estimation. Two common approaches include:

- Simple hold-out (back-test): Split the sample data into two portions. Use the earlier portion of the sample data to build the model, then forecast the next few time periods. Compare these forecasts to the actual

8 Multicollinearity occurs when two or more independent variables are highly correlated, leading to significant losses in the precision of the measurement of the variables' effect on the dependent variable.

9 Overfitting occurs when a model learns the training data, including its noise, too precisely that it can no longer make reliable predictions on new data

Back to Table of Contents

values a pre-defined evaluation criteria.10 This provides a single snapshot of how well the model performs on "new" and "unseen" data.

- **Rolling-origin / expanding-window cross-validation:** To avoid reliance on one split, repeat the exercise over multiple forecast origins: shift the estimation window forward step-by-step (rolling or expanding), re-estimate the model each time and store the resulting errors. Averaging these errors yields a more stable measure of predictive performance and reveals how accuracy changes with the forecast horizon.

Use Model to Derive Forecast Traffic Values

By entering the predicted values for the independent variables in the model, the forecaster will derive the forecasted cargo traffic.

Evaluate Results in Context of Historical Traffic Patterns

Once the results are developed, they should be compared to historical traffic patterns to ensure reasonability. For example, if there is a close relationship with the independent variables, the future independent variables should have the same type of pattern.

Compare with Benchmark Forecasts

As a final step to ensure reasonability, benchmark forecasts can be used as a comparison to confirm the projected growth is realistic.

5.3.4 Market Share Forecasts

Market share forecasts project airport activity as a percentage of a larger, more readily available aggregate forecast (i.e., state, regional or national level forecast).

This approach involves a review of recent forecast results in terms of annual growth rates and determining which can best be applied over the forecast horizon. A market share forecast is prepared when compiling growth rates and the outlooks of national forecasts, such as the FAA Aerospace Forecast, the Boeing Current Market Outlook and the Airbus Global Market Forecast. This type of forecast is developed by applying these collected consensus growth rates used in these forecasts to historical data.

Stakeholder input is then taken into account for consideration of factors that might not be present in prior forecasts, such as changes in market behavior due to the economy. Special consideration must be given to the state of the industry during the forecast, as well as additional due diligence to fully understand the airport's current and potential future role to fine-tune each airport forecast.

5.3.5 Hybrid Forecasts, Ensemble Approaches, and Other Advanced Techniques

Hybrid forecasting methodologies, combinations of the approaches described above, have become increasingly common. These approaches often divide the forecast horizon into phases, such as near-term and long-term, allowing analysts to leverage the strengths of different methods to improve overall accuracy.

For instance, in the near term, supply conditions are typically more fixed. Therefore, a supply-driven approach using recent trend analysis and up-to-date information on trade policies and market dynamics can enhance forecast precision. In contrast, for the long term, it's important to incorporate broader economic drivers and structural supply factors.

Another widely used technique is the ensemble forecasting approach. By combining forecasts from multiple models, the idiosyncratic errors of individual methods tend to cancel out and thus improve overall accuracy. A basic ensemble method uses a simple average of the forecasts. More sophisticated versions apply weighted averages, where the weights are determined by each model's historical performance or goodness-of-fit.

Lastly, the rapid growth of cargo digitization has given planners access to larger and more granular datasets than ever before. As a result, airports and integrators can now supplement the traditional methods outlined above with machine learning (ML) and other artificialintelligence (AI) tools to improve forecast accuracy, especially in environments marked by nonlinear relationships or sudden structural change.

10 Although they are beyond the scope of this guidebook, common evaluation criteria include Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), or Mean Absolute Scaled Error (MASE), among many others, and can be found in standard forecasting textbooks.

Back to Table of Contents

Key approaches in current practice include:

- Supervised ML models such as gradientboosted trees or random forests can capture complex, nonlinear interactions between cargo volume and dozens of explanatory variables (e.g., fuel price, online retail indices, currency movements)
- Neuralnetwork architectures are increasingly used for highfrequency timeseries forecasts where seasonality and shortterm shocks are pronounced
- Hybrid ensembles combine ML results with econometric or timeseries baselines, allowing forecasters to leverage the strengths of each method while reducing modelspecific bias
- Automated feature selection and anomaly detection help identify new demand drivers (for example, realtime ecommerce order data) and flag sudden deviations that may signal supplychain disruption

While a full tutorial is beyond the scope of this guide, planners are encouraged to monitor developments in MLenabled forecasting. Industry providers now offer turnkey platforms that allow airports to pilot these tools at modest cost, often integrating them with familiar econometric or timeseries workflows. Including at least a highlevel assessment of ML feasibility in the forecast design phase can ensure that the chosen methodology remains both current and fit for purpose.

Table 1 – Forecast Methodologies

Method	When Most Appropriate	Data Needed	Forecast Horizon	Use Cases	Key Strengths	Principal Limitations
Simple Growth Rate	Few historical observations are available; a quick "order of magnitude" estimate is required; external consensus growth rates (e.g., FAA Aerospace Forecast) are accepted by stakeholders	1–3 recent years of aggregate tonnage or RTMs; an external growth assumption	Short (≤ 5 yrs)	Early scoping, sensitivity checks, preliminary CAPEX screening	Very easy to apply; minimal data and time	Ignores economic drivers; extrapolates past trend; forecast error grows rapidly with horizon
Time Series Analysis	≥ 5–10 consecutive years of consistent airport traffic data exist; stable market with discernible trend/seasonality; little need to explain correlations or causality	Continuous historical series (monthly or annual) of the variable to forecast	Short to medium (3 – 10 yrs)	Budget planning, staffing forecasts, near term PAL triggers	Captures seasonality and momentum; modest technical skill required	Purely statistical; cannot test policy or macro scenarios; vulnerable to structural breaks
Econometric / Causal Model	Planners need to test "what if" scenarios (GDP, trade tariffs, fuel cost, etc.); sufficient historic data on traffic and explanatory variables are available; need to conduct long term strategic or financial evaluation	≥ 10 yrs of traffic; matching time series for GDP, population, income, fleet mix, etc.	Medium to long (5 – 20 yrs)	Master plans, bond financing cases, policy impact studies	Links traffic to drivers; supports scenario & sensitivity analysis; generates confidence intervals	Data and skill intensive; model risk (over fitting, multi collinearity); dependent on quality of exogenous forecasts

Back to Table of Contents

Market Share (Top-Down)	Reliable regional/ national forecast exists (e.g., FAA TAF, Boeing WACF); airport's historical share is stable or evolves predictably; competing airport dynamics are central	Historical airport share vs. larger market; regional/ national forecast series	Medium to long (5 – 20 yrs)	Competitive strategy, catchment leakage studies, hub location screening	Leverages richer external forecast; fast to implement; highlights share shifts	Accuracy hinges on share assumption; cannot capture airport specific shocks independently
Hybrid / Ensemble	Both short term tactical and long term strategic views are required; decision makers want robustness against model risk	Data required by component methods (e.g., time series + econometric)	Any (multiple horizons)	Complex master plans, uncertainty analysis, risk adjusted investment timing	Combines strengths, mitigates idiosyncratic errors, accommodates phased horizons	Highest data and analytical burden; requires clear governance to reconcile divergent results

6. Example Forecast

This section presents an example forecast for which a single approach did **not** yield reasonable results. As a result, a combination approach was applied, using trend analysis, industry forecasts, and an econometric regression approach. This example illustrates the need for professional judgment in the forecasting process.

Airport Cargo Forecast

This air cargo tonnage forecast was conducted using several sources of economic and traffic data such as Airbus Global Market Forecast 2009-2028, the Federal Aviation Administration (FAA) Aerospace Forecasts 2010-2030, the International Monetary Fund (IMF) and Moody's Economy.com.

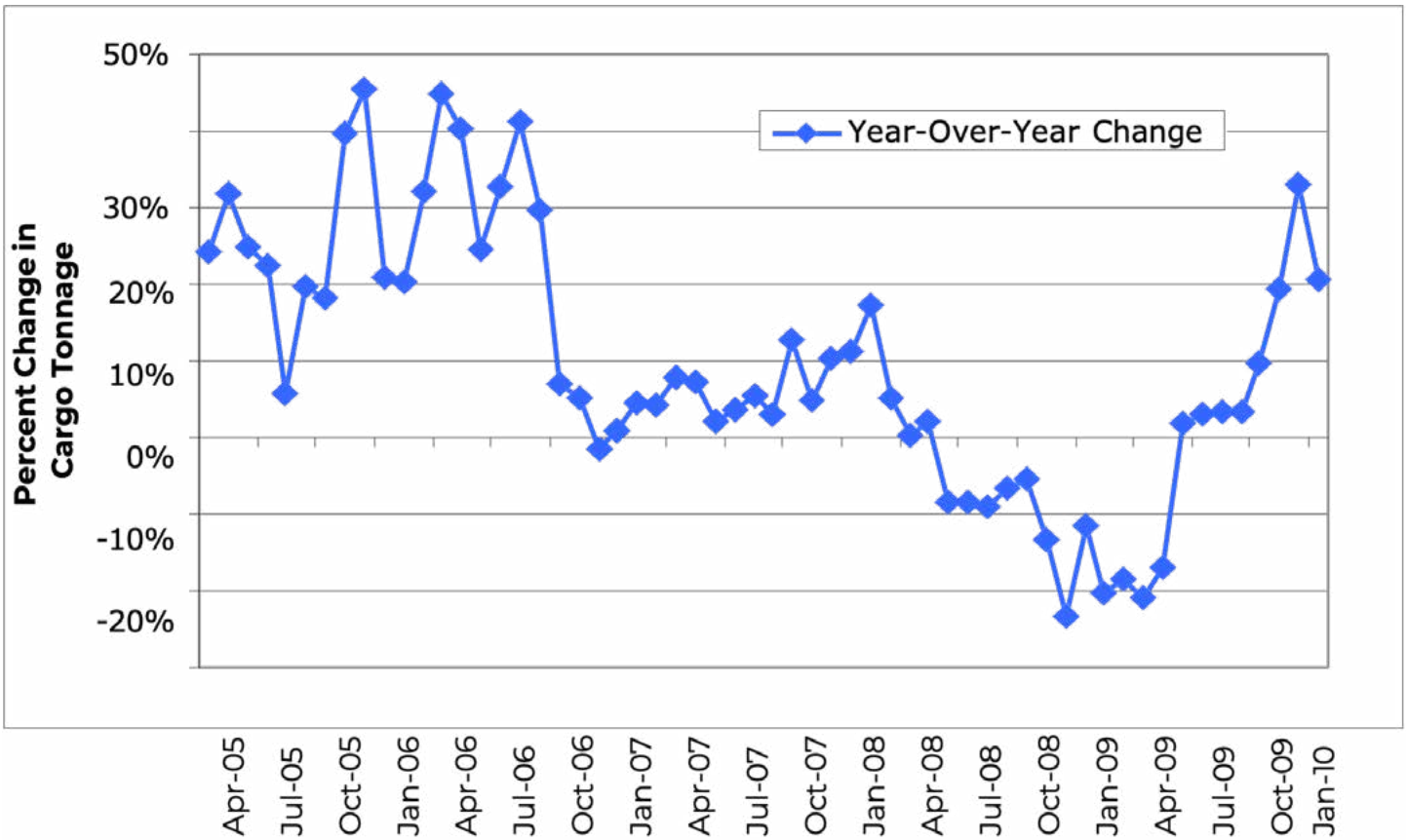
A linear regression against the Real Gross Domestic Product (GDP) was used as a basis for the air cargo tonnage forecast at the Airport. Although this methodology provided reasonable results in the long term, near-term trends appeared to be underestimated and more reflective of a mature market. As a result, a two-step process was used to develop the cargo tonnage forecast:

- A near-term approach considered recent trends in air cargo tonnage at the Airport which provided the opportunity to incorporate a more appropriate year-to-year estimate of the impact of the current economic crisis and subsequent recovery on cargo traffic levels.
- Air cargo tonnage was correlated to the Real GDP from 1998 through 2010. This statistical relationship was used as a long-term approach (2010-2030). The long-term approach also focuses on the major forecast trends for the air cargo industry provided by Boeing and Airbus. Near-Term Forecast

According to tonnage records provided by the airport, Airport cargo volumes were down 10.3 percent in 2009. The months of December 2008 through May 2009 saw air cargo volumes at the airport drop 13 to 23 percent compared to the same months a year before. After a period of somewhat stable cargo tonnage levels (June 2009 through September 2009), air cargo volumes at the airport increased sharply, showing growth of 19 to 33 percent in November 2009 through January 2010 compared to the same months a year earlier.

Back to Table of Contents

MONTHLY AIR CARGO TRENDS



Sources: Airport records; Consultant analysis

Year-over-year growth in air cargo tonnage at the airport from 1998 through 2010 was compared to the growth in Real GDP over the same period. From 1999 through 2010, air cargo tonnage at the airport grew 2.0 times faster than GDP. Cargo tonnage growth at the airport was affected by the current economic crisis as reflected in years 2009 and 2010. If the past two years were excluded, air cargo volumes at the airport would appear to have grown 2.5 times stronger than GDP.

GDP multipliers at the airport were also compared to benchmark airports. Air cargo data for two similar airports were analyzed from 2000 through 2008 and compared to growth in Real GDP over the same period. The average GDP multiplier over the past nine years was estimated at 2.1 for cargo tonnage at both benchmark airports.

Based on these analyses, it was assumed that a multiplier of about 2.1 would be appropriate in 2011 as air cargo volumes at the airport would continue to recover from the recent economic downturn. The GDP multiplier is expected to decrease through the recovery period to about 1.6 by 2015.

Long-Term Forecast

A statistical regression analysis was conducted between cargo tonnage back to 1998 and Real GDP. Overall, this forecast expects Real GDP to grow 7.1 percent per annum from 2010 through 2030. The air cargo tonnage forecast derived from the regression analysis shows an average growth of 8.4 percent per annum through 2030, resulting in a long-term GDP multiplier of about 1.2.

Therefore, as the airport's cargo market becomes more mature, it was assumed that the GDP multiplier would continue to decrease from 1.6 in 2015 to 1.1 by 2018. It is expected that the multiplier would slightly decrease to 1.0 by 2026 and remain constant throughout the remainder of the forecast period.

Back to Table of Contents

Air Cargo Tonnage Forecast Summary

As a result of the forecasting process, air cargo volumes were expected to grow 9.1 percent annually from 170,900 tons in 2010 to 975,700 tons in 2030.

AIR CARGO TONNAGE FORECAST

YEAR	AIR CARGO TONNAGE	ANNUAL % CHANGE	REAL GDP	ANNUAL % CHANGE	GDP MULTIPLIER
Actual					
1998	44,549		17,188		
1999	43,745	-1.8%	18,223	6.0%	-0.3
2000	52,152	19.2%	19,520	7.1%	2.7
2001	58,026	11.3%	20,307	4.0%	2.8
2002	68,481	18.0%	21,367	5.2%	3.5
2003	87,143	27.3%	22,171	3.8%	7.2
2004	94,203	8.1%	24,027	8.4%	1.0
2005	112,374	19.3%	26,016	8.3%	2.3
2006	140,922	25.4%	28,420	9.2%	2.8
2007	165,488	17.4%	31,189	9.7%	1.8
2008	177,712	7.4%	34,023	9.1%	0.8
2009	159,386	-10.3%	36,094	6.1%	-1.7
2010	170,900	7.2%	38,412	6.4%	1.1
Forecast					
2015	326,600	12.9%	56,216	8.6%	1.5
2020	528,600	7.7%	84,180	7.0%	1.1
2025	744,000	6.7%	114,985	6.1%	1.1
2030	975,700	5.2%	150,799	5.2%	1.0
CAGR					
1998-2010	11.9%		6.9%		
2010-2020	12.0%		8.2%		
2020-2030	6.3%		6.0%		
2010-2030	9.1%		7.1%		

CAGR = Compound Annual Growth Rate

Sources: Airport records; IMF; Moody's; Consultant analysis.

Air Cargo Tonnage By Segment

Airbus and Boeing forecasts were reviewed to segment the air cargo tonnage forecast into domestic and international categories. For purpose of this forecast, it was assumed that the dedicated cargo freighters would continue to drive growth in domestic cargo tonnage at the airport in line with the Boeing growth rate. Therefore, domestic cargo tonnage was expected to grow 10 percent annually through 2030. International air cargo volumes would grow at a slower rate of 8.4 percent per year.

As a result of the increase in express freight volumes at the airport, domestic belly cargo tonnage was expected to account for a decreasing share of total domestic cargo volumes at the airport. Accounting for about 73 percent of total domestic air cargo tonnage in 2010, domestic belly tonnage share was expected to decrease to about 60 percent by 2030. Both domestic and international belly cargo tonnage was assumed to benefit from the robust growth in domestic and international passenger movements forecast. Therefore, international belly tonnage was expected to grow at a stronger pace than international freighter tonnage. International freighter tonnage was assumed to remain at about a third of international cargo tonnage as combination carriers were expected to continue to deploy all-cargo flights in and out of the airport.

Back to Table of Contents

AIR CARGO TONNAGE FORECAST BY SEGMENT

SEGMENT	YEAR					CAGR 2010-2030
	2010	2015	2020	2025	2030	
Domestic						
Belly	49,636	94,700	151,800	211,800	275,200	8.9%
All-Cargo	18,358	40,500	76,400	123,400	183,400	12.2%
Total	67,994	135,200	228,200	335,200	458,600	10.0%
International						
Belly	69,461	131,000	209,100	289,400	372,300	8.8%
All-Cargo	33,444	60,400	91,300	119,400	144,800	7.6%
Total	102,906	191,400	300,400	408,800	517,100	8.4%
Total						
Belly	119,097	225,700	360,900	501,200	647,500	8.8%
All-Cargo	51,803	100,900	167,700	242,800	328,200	9.7%

CAGR = Compound Annual Growth Rate
Sources: Airport records; Consultant analysis.

Freighter Movements Forecast

All-cargo tonnage was forecast to grow 9.7 percent per annum from 51,803 metric tons in 2010 to 328,200 tons in 2030. Over this period, all cargo carriers were expected to increase available capacity and load factors as a response to increasing demand. However, some of the cargo carriers at the airport operate on multi-stop itineraries, stopping at the airport to unload and load only a portion of their overall tonnage. Therefore, it was assumed that the carriers currently operating on multi-stop itineraries would not materially change their operational practices over the forecast period. The forecast projected an increase in tonnage per flight and load factors to account for a portion of the routes that were operated on a non-stop basis.

The following carrier specific assumptions were considered in the development of the cargo movements forecast:

- The six all-cargo carriers would compose the main core of all-cargo traffic at the airport over the forecast period.
- The largest domestic all-cargo carrier at the airport accounted for 39 percent of all-cargo tonnage and 51 percent of all-cargo movements in 2010, using mainly Boeing B757 and B737 aircraft. This carrier was expected to remain the largest domestic all-cargo carrier at the airport over the forecast period. The airline would continue using Boeing B737 but would focus most of its growth on the larger Boeing B757 aircraft.
- A cargo carrier that specializes in express freight with service to its hub currently operated ATR-72 aircraft at the airport (Code C)[4]. Based on current fleet plans, it was assumed that the airline would continue to use primarily Code C aircraft at the airport with the addition of some Code D aircraft such as the Airbus A310. Destination focus was expected to remain on roundtrips to its hub.
- A regional carrier recently switched to all-cargo activity using Boeing B737-200 aircraft. The airline was expected to increase its frequency at the airport using Code C aircraft composed of Boeing B737- 200 and ATR-42 aircraft.
- In addition to these three carriers, new entrants would likely emerge in the domestic market focusing on express freight services in line with Airbus and Boeing forecasts. The new domestic all-cargo carriers were assumed to focus on point-to-point service using small Code C aircraft such as the ATRs.
- International all cargo carriers operated mainly non-stop service using Code E aircraft. It was assumed that these airlines would continue to deploy Code E aircraft between their hubs and the airport over the forecast period. Asia and Europe would remain the main trade partners at the airport; however, cargo flows to and from Middle East were expected to grow faster than these two regions. Code F aircraft such as Boeing B747-800 were assumed to be deployed starting around 2020. Code E aircraft such as the

Back to Table of Contents

Airbus A330 would progressively replace aging Airbus A300s and A310s.

As a result of these assumptions, all-cargo movements were expected to increase from 3,621 movements in 2010 to 19,960 movements in 2030, averaging growth of 8.9 percent per annum. Tonnage per movement was forecast to grow from 14.3 in 2010 to 16.4 by 2030. International all-cargo movements would grow at a slower rate than domestic all-cargo traffic due to the use of larger aircraft over the forecast period.

FREIGHTER MOVEMENTS FORECAST BY SEGMENT

SEGMENT	YEAR					CAGR 2010-2030
	2010	2015	2020	2025	2030	
Domestic						
Tonnage	18,358	40,500	76,400	123,400	183,400	12.2%
Movements	2,615	5,060	8,490	12,340	16,670	9.7%
Tonnage per Movement	7.0	8.0	9.0	10.0	11.0	
International						
Tonnage	33,444	60,400	91,300	119,400	144,800	7.6%
Movements	1,006	1,590	2,280	2,840	3,290	6.1%
Tonnage per Movement	33.2	38.0	40.0	42.0	44.0	
Total						
Tonnage	51,803	100,900	167,700	242,800	328,200	9.7%
Movements	3,621	6,650	10,770	15,180	19,960	8.9%

CAGR = Compound Annual Growth Rate
Sources: Airport records; Consultant analysis.

Code C and Code D aircraft would constitute most of the growth in domestic all-cargo traffic at the airport. Code E aircraft would be introduced in 2020 to account for about 4.0 percent of domestic all-cargo movements by 2030. On the international side, Code E aircraft would account for an increasing share of international all-cargo movements from 81.5 percent in 2010 to 86 percent in 2030, progressively replacing Code D aircraft. To respond to increasing cargo tonnage levels, Code F aircraft would be deployed starting in 2020 and would account for about 10 percent of international all-cargo movements by 2030.

[4] ICAO Aerodrome reference code is defined in ICAO Aerodrome Design and Operations Manual –page 17: http://legacy.icao.int/fsix/_Library/Manual%20Aerodrome%20Stds.pdf

FREIGHTER FLEET MIX FORECAST

AIRCRAFT CODE	YEAR					CAGR 2010-2030
	2010	2015	2020	2025	2030	
Domestic						
Code C	1,009	2,330	3,740	5,180	6,340	9.6%
Code D	1,606	2,730	4,640	6,910	9,660	9.4%
Code E	-	-	110	250	670	n.a.
Total	2,615	5,060	8,490	12,340	16,670	9.7%
International						
Code D	186	320	320	320	320	2.8%
Code E	820	1,270	1,910	2,370	2,640	6.0%
Code F	-	-	50	150	330	n.a.
Total	1,006	1,590	2,280	2,840	3,290	6.1%
Total	3,621	6,650	10,770	15,180	19,960	8.9%

CAGR = Compound Annual Growth Rate
Sources: Airport records; Consultant analysis.

Back to Table of Contents

7. Conclusion

Cargo forecasts are important in understanding an airport's demand growth, assessing market risk, and predicting financial gains/losses to develop management strategy. Often, forecasting is mandated in master plans to secure funding for future capital improvement projects, particularly under federal grants and bond issuances. Airports that accurately forecast their future traffic will better anticipate the needs of their customers and thus will be in a better position to develop to their full potential.

Forecasting cargo demand is not an exact science where the same approach can be applied at all airports. Each airport presents its own unique set of variables that need to be considered. A variety of forecasting approaches were presented in this guide. Each of these techniques has its own set of advantages and drawbacks, and they may be used independently or in combination. No one approach is always the best. The application of professional judgment is critical.

Because forecasting cargo demand is an inherently uncertain activity, the use of PALs and continuous monitoring of actual cargo activity can be critical. The use of PALs reflects that the timing of any necessary improvements will not be driven by a set point in time but rather by the timing and arrival of future demand levels. The actual realization of predicted activity levels will likely differ from the forecast in terms of what year that activity occurs. The PALs represent activity-based milestones that can be used to make future expansion and development decisions, focusing on specific volumes of activity that trigger the expansion requirement, rather than the timing identified in the forecast.

Reliable forecasts provide critical input for airport management and planning. Although forecasting is a challenging task, the application of the principles in this guide can allow more dependable and useful cargo forecasts. It is important, however, to remember that forecasting is a tool, and that it remains the responsibility of management to review the end products with a critical eye and check against the airport's core strategies and beliefs.

Back to Table of Contents

Chapter 4

Air Cargo Facility Analysis

Back to Table of Contents

1. Introduction

The purpose of the Air Cargo Facility Analysis section is to identify trends in the air cargo industry that have had an impact on facility development, identify what those impacts are, and recommend changes to the standards for developing facilities. Many of the changes may result in the demand for additional land, which is a scarce commodity at many airports. As such, this section also describes techniques for better utilizing existing airport land. Finally, this section addresses operational and capacity management issues relating to facility development.

Like passenger terminals, parking garages and runways, the development of air cargo facilities generally follows a process. Due to the somewhat unique nature of the air cargo market, this process can be more complicated than that for other airport facilities, however, the development process can be generally defined for an airport operator by answering six questions.

What is the cargo market at my airport?

The first phase of any cargo development program should include a market assessment to establish geographic market size and growth. If the results are favorable, subsequent phases would include selection of target markets and market surveys. The term “cargo market” does not just refer to the potential for the flow of goods (the operating market) but also pertains to the potential for cargo facilities at an airport (the leasing market). It is very important for an airport operator to answer this first question to develop a strategy for determining air cargo facility capacity.

How do I develop the market?

Once the cargo market is identified, the next step is to determine a strategy to develop that market. The best way to develop the market is to survey the people who are involved in the movement of goods into and out of the community. This includes in addition to the carriers, air cargo associations, freight forwarder and customs broker associations, trucking, major manufacturers, Chambers of Commerce and Economic Development organizations, which are all very good sources of information about what is entering and exiting the local marketplace. Due to competitive concerns, the information will be somewhat general, but it will still provide the necessary input to determine the existing market and areas of potential growth. Developing the market brings into play the “chicken and egg” scenario. The forwarders say that they will generate the cargo if the service is available and the carriers say that when the cargo exists they will provide the service. Developing the market requires bringing the two elements together to overcome this barrier.

How do I sell the Market?

Selling the market requires convincing the airlines and other cargo operators that there is a profitable opportunity for them to commence service to your market. Preparation of presentations showing volumes of existing cargo along with growth potential, the benefits of using your airport, the availability of facilities and infrastructure and the support of the forwarder community is important. Some airports are offering incentives to new entrants but keep in mind that the FAA requires that incentive programs be offered in an equitable manner available to all carriers.

What are the facility requirements?

Once an airport operator has a general understanding of the cargo market and how to develop it, the next step is to identify the location, type and size of facilities needed to satisfy the market demand. This should include existing and projected future demand.

Do I have the right facilities?

Having the right types of facilities means:

- Having an adequate supply of cargo buildings, staging, storage areas, landside infrastructure and apron in the optimal location
- Understanding the mix of carriers, and the support services required by the entity to which the facility could be leased, and the warehousing, office, and ground service equipment (GSE) space as well as the

Back to Table of Contents

landside and aeronautical infrastructure they require for cost-effective operations

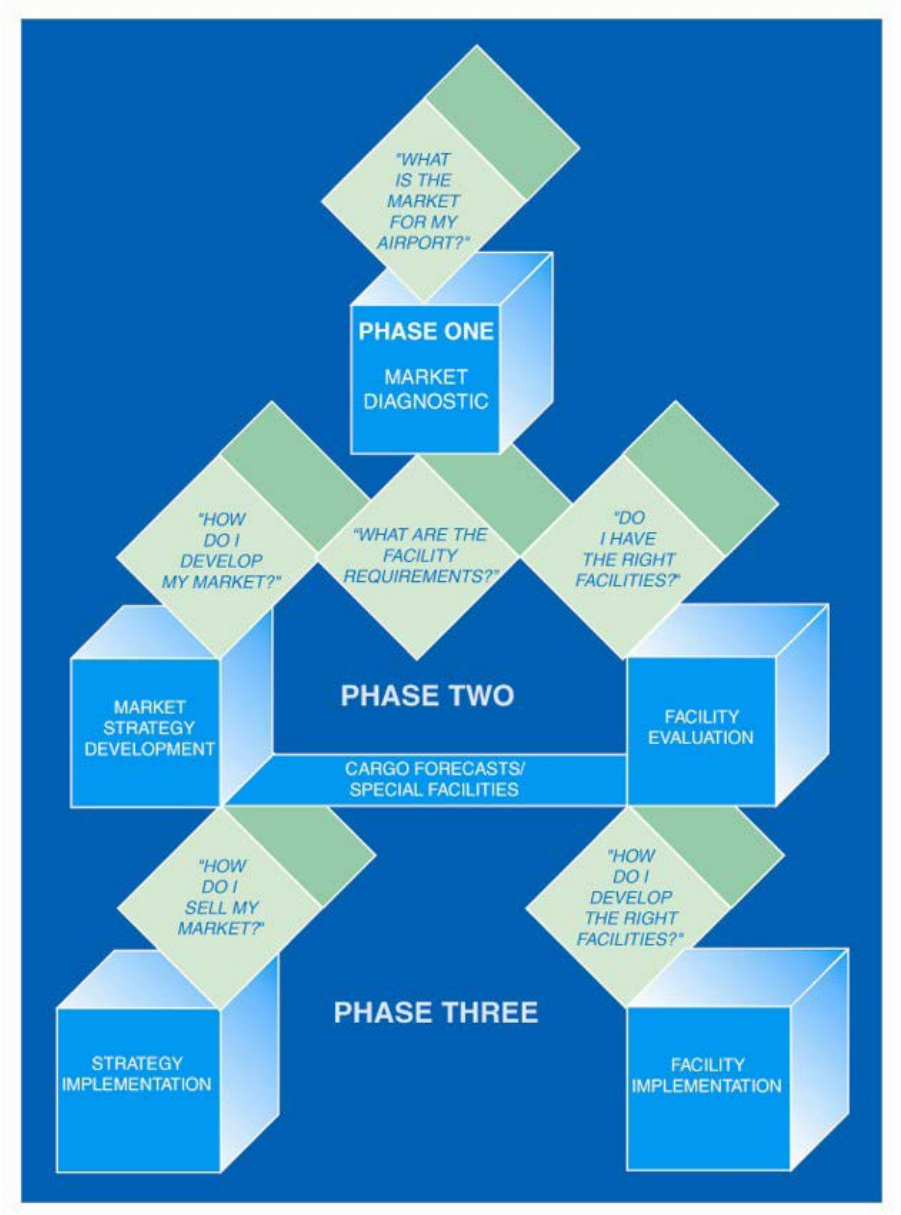
- Determining the appropriate throughput for the potential tenants and users of the facility
- This phase of the development process usually includes a site selection study for future air cargo facilities. Once a site has been selected, the best layout of facilities on the site is determined. Cost estimates are then developed for the final cargo facility layout

How do I develop the right facilities?

This phase of the facility development process involves determining whether the airport operator undertakes the project itself or contracts the development to the private sector, including the financing of the proposed development and the design/construction of the facilities. The airport also must decide how the new cargo facilities will be managed and operated.

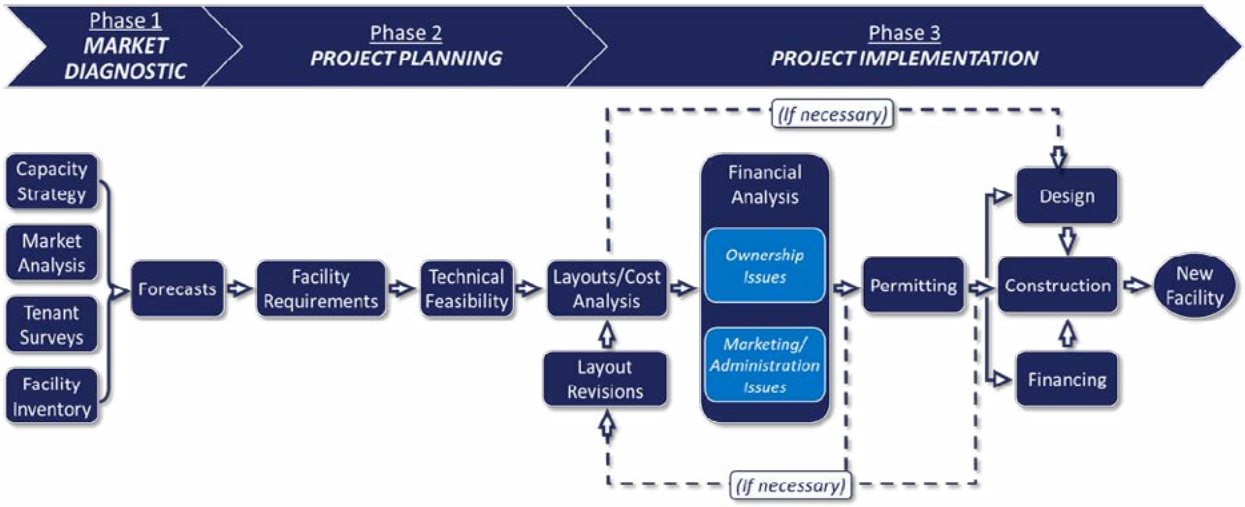
Two figures are provided to show the general air cargo facility development process. Figure 1 is a summary of the six questions identified above and outlines the marketing aspects of air cargo facility development. The marketing process is covered in detail in other sections of this Guide. The facility development process is covered in this section. Figure 2 depicts the facility development process in more detail. The air cargo facility analysis provided in subsequent sections follows the development flow outlined in Figures 1 and 2.

Figure 1



Back to Table of Contents

Figure 2



2. Capacity Concepts

In the past, airports have been consistently late in anticipating and meeting air cargo facility demand. This delay created a very predictable infrastructure crisis. In case after case, a shortage of efficient, properly located, air cargo facilities are preceded by a carrier or carriers expressing a serious unmet need for greater and more efficient space. Efficiency is the key; a cargo facility should be the right size and configuration for the potential market. Today, there is a shortage of air cargo infrastructure and facilities at many airports: at the same time, as the markets shift, it also appears that an overcapacity situation exists at other airports around the country as well. The following discussion outlines various issues to consider depending on individual circumstances.

In the past, airports were consistently late in addressing cargo infrastructure demand while today overcapacity might be more the norm.

Almost any airport can reduce the potential for a capacity crisis. This does not pertain to every airport because there are other factors that can lead to capacity problems.

Cargo facility shortage has been more of an issue than excess capacity situations. However, beyond the sheer numbers, shortages create much more severe problems for an airport. Marketing to potential new cargo customers, retaining existing cargo customers and managing operating costs are impacted negatively by facility shortages. These problems will be addressed in more detail later in the analysis.

The predictability of a crisis resulting from the lack of airport infrastructure to meet growth, it is the "wake-up call" upon which the industry has relied that is the culprit. This "wake-up call" is exemplified by an anonymous cargo customer: "Our needs greatly exceed available infrastructure at the airport and we seriously require more building space, ramps, truck docks, vehicle parking, GSE and container storage and maintenance areas." The alarm continues to ring with revelations the cargo customer has already explored all available options and has decided to divert lift capacity or cargo shipments to another airport. Once the first call is received, it normally signals the beginning of similar calls.

This early warning system the industry has adopted is akin to a wind-shear detection system. Such a system is of no value if it is installed after a decision has been made. Because of issues related to limited availability of market intelligence and/or concerns regarding speculative development, the industry has long utilized current carrier demand to determine and act upon future infrastructure requirements. This method has numerous shortcomings and should only be utilized as a segment of a much more comprehensive planning and action effort. The situation is exacerbated by the concern of developing on a speculative basis, space that might go unleased.

This chapter is to identify approaches that may be employed to reduce the potential for air cargo infrastructure capacity problems. These problems can take two basic forms, each of which can create significant economic and political difficulties for an airport. Both infrastructure overcapacity and under capacity represent substantial challenges.

Back to Table of Contents

2.1 Capacity Impact

This analysis focuses on reducing potential capacity problems, whether it is a shortage or a surplus of facilities. Excess air cargo facility capacity, which appears to be the case at several airports today, is a serious problem. A multitude of factors have contributed to this situation, including building facilities without a thorough understanding of the market and failure to recognize inevitable fundamental changes in the industry such as shifts in routes, shifting distribution patterns, etc. The key to avoiding overcapacity is to build facilities with flexibility in mind.

On-airport cargo facilities are designed differently to accommodate combination carriers (both passenger and cargo) versus freighter operations. Excess capacity often occurs in combination carrier facilities, which are not typically contiguous to aircraft parking aprons. This removed location is acceptable provided tug access is available. Freighter operators may find a facility with a contiguous parking apron, which offers operational and cost efficiency. For these carriers, cargo facilities removed even a short distance from the airplanes are problematic. It is ill-advised for an airport to try to force carriers to operate from facilities that are removed from the parking ramp. With increasing frequency, these airports are discovering that rather than accepting a less efficient facility location, the carrier will find alternatives. These alternatives include utilizing another airport completely or shifting some lift capacity to another airport or mode of transportation. Carriers and cargo customers have choices.

The key to avoiding overcapacity is to build facilities with flexibility in mind.

A level of overcapacity can produce some benefit for an airport's carriers and supporting businesses. In some instances, based on lease requirements, a level of facility vacancy can help control or drive down rental rates. Surveys reveal that as facilities on-airport reach capacity, rental rates increase. The higher the rental rates, the higher the operating costs for users and the more incentive for them to explore alternatives. A second benefit of excess capacity is the ability to accommodate demand generated by successful marketing. Once a customer has decided to serve a new market or increase service to a regional market area, it is normally too late to tell the customer that facilities can be ready for occupancy within a year. More than one opportunity was lost in this circumstance when the customer went down the road 250 miles to an airport that had infrastructure available immediately (e.g. SEA vs PDX vs BFI, ORD vs RFD vs GYY). Cargo customers are not solely dependent on passenger preferences and may have greater flexibility in selecting an airport.

Another factor that can lead to overcapacity, particularly in small and medium sized airports is the downsizing from larger passenger jet aircraft to smaller regional passenger jet aircraft. Although the trend has reversed in the last several years and regional jets are larger, they still do not have significant cargo capacity. As a result, the trend towards greater use of integrated carriers and trucking cargo to larger airport markets will continue. Carrier cargo handling consolidation and carrier consolidation in general, including code sharing, can also lead to overcapacity at an airport. Carriers are increasingly replacing their own employees with third-party cargo handlers. In some cases, the third-party can also be another carrier. It is not uncommon to now see third-party cargo handlers processing cargo for multiple carriers through the same facility (a "common use" facility), making more efficient use of the space and thereby increasing the effective capacity of the facility. In addition, airports are developing open floor plan buildings (no partitions) which enable the same building to be used throughout the day to accommodate various peaks.

Regardless of the reason for overcapacity at an airport, it is an appropriate time to plan for the next wave of demand. Closely monitor individual carrier demand by building. If appropriate, use this time to upgrade existing facilities to make them more efficient, incorporate the latest technology, or demolish obsolete facilities and replace them (subject to market demand) with modern, state-of-the-art facilities built to current standards.

2.2 Infrastructure Strategy

It appears the most successful approach, from a macro-analysis, is to develop a strategy for infrastructure development, evaluate the strategy frequently for effectiveness, modify the strategy to reflect the changing environment and implement the strategy in a timely manner. Macro-analysis is of little help unless it is broken down into components with which everyone can deal.

Back to Table of Contents

Strategy Development

The first step is to determine the market of cargo customers for a particular airport. This entails two population elements. The first is the customer base that the airport would like to attract. Marketing brochures, personal visits, trade shows and a multitude of promotional materials are developed and utilized each year by airports trying to entice potential cargo customers. An equally important part of the strategy should be retention and growth of current users. A realistic assessment of potential users is essential but the priority is to ensure your existing customers are well served.

Significant resources are expended each year to attract new cargo customers; however, the priority should be to ensure your existing customers are well served.

Once the existing and potential user-base is identified, the second step is to generate an inventory of the airport's strengths and weaknesses, develop strategies to maintain those strengths (advantages) and eliminate or mitigate the weaknesses (disadvantages). This phase requires an objective examination of the airport's cargo infrastructure. This includes assessing available land, facility condition, apron capacity, landside access and the ability to accommodate advanced technologies such as electric ground service equipment (eGSE), autonomous cargo tugs and smart building systems. This must be evaluated to determine whether it provides an appropriate level of efficiency for the existing cargo volumes and projected short-term growth and whether the resources exist to support additional cargo customers.

First, ensure that existing users are served by meeting their needs at the local level. If local cargo managers are concerned about tug distances to aircraft, tight warehouse space, poor truck access or maneuvering areas or any other infrastructure problem, even though these types of concerns may appear less pressing to the airport, it will provide an early clue of larger problems to come. These local managers will be passing on the same concerns along with regional and national decision-makers and link inefficiencies, budget overages, delays and poor performance to inadequate infrastructure.

There is no substitute however for frequent and meaningful personal contact with local, regional and national decision-makers in the planning and operations areas of the carriers and other cargo customers. They will share concerns, ideas and observations that are invaluable in attracting and retaining cargo customers. This process will warn us of evolving infrastructure issues and is the single greatest source of identifying potential opportunities.

Using qualitative information gathered from industry sources, combined with quantitative measures, an inventory of existing infrastructure can be compared with the targeted improvements. If the existing infrastructure does not meet current and short-term growth needs, that problem should be addressed immediately. A breakdown at this planning level indicates a potentially serious customer retention problem. In the event existing infrastructure efficiently supports current cargo volumes and projected short-term growth, it is time to compare infrastructure potential with the long-term strategy. If the long-term growth scenario requires land for facility development, which is not available, a revision in strategy is obviously necessary. In other words, the airport should perform a matching of business goals with capacity potential.

There is no substitute for frequent and meaningful personal contact with local, regional and national decision-makers of the carriers and other cargo customers.

Strategy Evaluation

Normally, those responsible and accountable for a strategy know whether it produces the desired results. It is not enough to know whether the plan is working effectively or has failed to produce the desired results. Simply assuming the strategy worked because the targets are being achieved may overlook the potential that success was attributable to other factors or that greater success could have been achieved. If success was the result of other factors, it is important to identify and capitalize on these attributes. If the strategy failed to achieve the targeted objectives it is equally important to understand the weaknesses to adjust.

Evaluation should also be timely and frequent. Clear and defined evaluation points should be established as part of the strategy. This allows for mid-stream corrective action and adjustments.

Strategy Modification

Although the strategy to provide infrastructure cannot anticipate every possible scenario, it can incorporate a process that makes modification part of the strategy itself. Expect change and factor it into the process. Change can have either a positive or negative impact on a facility. Identify potential sources of change and monitor those sources. Key external drivers to monitor include, but are not limited to:

Back to Table of Contents

- Security requirements, such as TSA's evolving Certified Cargo Screening Program (CCSP) and ICAO Annex 17 standards.
- Technology advancements, including AI-driven cargo sortation, warehouse robotics, and real-time data integration.
- Industry consolidation and modal shifts, as carriers optimize air–truck intermodal operations and introduce low-carbon logistics.
- Sustainability and energy mandates, influencing building design and equipment electrification. Security Requirements

Security requirements will continue to play a major role in how cargo facilities are built and operated. Cargo security requirements incorporate a level of increased cargo screening. This can occur at the point of origin with the shipper or forwarder, within individual cargo facilities or at a Certified Central Cargo Screening Program (CCSP) facility.

In general, most air cargo transported on passenger aircraft is screened at off-airport facilities through the CCSP administered by the Transportation Security Administration (TSA) and equivalent programs administered by international authorities under ICAO Annex 17. However, technological advances may make on-airport screening more efficient and more prevalent. CT technology is one such screening method that may become more commonplace in air cargo facilities. However, these machines require a large footprint.

Air cargo facility layout considerations should be made to include space within an air cargo building can be flexibly modified to meet changing security screening standards.

U.S. Customs and Border Protection (CBP) uses the Air Cargo Advance Screening (ACAS) Program to perform risk-based screening of all air cargo. In some cases, CBP may request that shipments be held at air cargo facilities for inspection. Air cargo facilities should have enough space to hold shipments should additional screening or review be required.

Employees with access to the Air Operations Area (AOA) are subject to a greater level of security background checks and screening. Airports should anticipate reduced AOA access points, more stringent biometric controls and integration of federated digital identity systems over the next decade.

Change in Technology

Technology can rapidly make a facility inefficient. There are numerous examples of this occurring and one glaring impact is the next generation of air cargo fleets. Tail heights of wide-body aircraft over narrow-body aircraft create parking problems and inefficiencies for many facilities due to airspace and airfield clear area setback requirements. Even some facilities designed and built within the last few years have failed to anticipate the next generation of aircraft with increased separation requirements. Another negative impact is the need for increased clear heights in newer facilities. To avoid premature obsolescence, facility planning should prioritize flexible design frameworks. Structural systems, clear heights, and utilities should allow for modular retrofits as technology evolves. A facility sponsor (airport, private sector, carrier) can create more space with automated technologies such as new stacking systems. The key is to examine evolving technology and, where feasible, make allowances for accommodation in the infrastructure later.

Industry Growth

Air cargo is the mode of transportation most impacted by globalization. Consider the effect this phenomenon has on physical planning. Until recently, gateways and large coastal metropolitan areas were synonymous. Evaluate the potential impact (positive or negative) industry growth and technology changes have on the airport and the region. Factor in code sharing, mergers, and international agreements.

Vertical and Horizontal Integration

Carriers, in an intensifying effort to strengthen market position, are integrating the services offered to customers beyond rapid and safe delivery of cargo. A growing segment is either providing or exploring warehousing, inventory management, order processing and other customer services. These trends and the next generation of services should be introduced to the infrastructure equation.

Back to Table of Contents

Operational Concepts

Carriers are constantly seeking new operational concepts designed to reduce costs and deliver cargo more efficiently. Once thought to be the ultimate in efficiency, hubbing operations can be impacted by changing distribution patterns and could be replaced by other concepts or modes.

Multi-Modal Transportation

Despite existing shipping preferences among modes, insightful planning will include multi-modal transportation aspects in any cargo infrastructure strategy. Anticipate the evaporation of the clear distinctions between land, sea and air cargo transportation. Air carriers are becoming truckers and vice-versa. Envision at some level, the integration of rail and sea and the impact on any strategy. Access to and from cargo areas on-airport must consider the geometric roadway and staging layout requirements of trucks.

New Generation of Larger Wide-body Aircraft

Boeing and Airbus created a new generation of wide-body aircraft that has had a dramatic impact on cargo capacity. Expanded belly capacity has reduced the need for freighters on some routes. This also creates the need for additional combination carrier cargo facilities and larger aircraft parking positions at these international gateways.

Local and Regional Economic Development

Any infrastructure strategy communicating and coordinating with local and regional economic development personnel has a much greater chance of achieving its objectives. The airport may represent one of the most important resources available to the local and regional economic development effort. Capital resources available for infrastructure creation and improvement are often difficult to secure and having support from the economic development team can facilitate raising capital.

Air cargo infrastructure development must be carefully integrated with the process of attracting and retaining air cargo carriers. Air cargo carriers have much more flexibility in selecting an airport and determining the magnitude of operations at an airport. Although an airport has little control over cargo volumes available to the carriers, it can create the infrastructure to support efficient operations. If the cargo volumes are available, you want them flown out of and into your airport. If the airport does not supply the necessary infrastructure, the competition will.

Cargo infrastructure can lead the successful process of attracting and retaining cargo operations

Air cargo carriers now transport freight more rapidly, further and more safely than at any time in history. This trend will continue. If the airports cannot contribute to the above equation they will be at a competitive disadvantage.

3. Facility Requirements

Due to the wide range of variables that could impact the operational efficiency of an air cargo facility, a clean and simple formula does not exist to project facility infrastructure needs at any given airport. There are tools available, which can assist in measuring current utilization and comparing the result with industry norms.

This chapter addresses quantitative methodologies currently employed to approximate cargo facility requirements for airports.

3.1 Total Land Area Requirements

At the macro master planning level, it is important to understand the total land area required to accommodate a typical air cargo facility. Total land area refers to the combined footprint of all functional areas that are associated with the operation of an air cargo facility (e.g., cargo building, aircraft apron, auto parking, truck trailer storage areas, etc.). Understanding the quantity of land associated with typical air cargo facilities can help planners and airport operators identify enough land areas to accommodate this demand.

This type of analysis can serve two purposes:

1. It can help determine the amount of space that should be allocated to accommodate an air cargo facility based on anticipated cargo volume.

Back to Table of Contents

2. It can help determine the approximate anticipated air cargo volume that can be achieved at that site based on a quantification of available land. This second analysis type is particularly helpful for land constrained sites and/or airports.

Airport planners can use a high-level cargo site utilization rate in cases when detailed cargo site information is not available. A planning factor for total cargo facility land area is 100,000 annual tons of air cargo per 700,000 square feet of land area for a typical integrated freight facility with a modest level of cargo volume. For example, the cargo facility site is comprised of cargo building, aircraft apron, airside GSE storage/staging and landside. This utilization rate was established through benchmarking several cargo operations at U.S. airports and can be used to support higher level planning analyses.

This total site utilization ratio can support preliminary land use planning for new cargo facilities, particularly for master plan level of analysis and/or greenfield sites. Airport planners and operations will need to coordinate with the cargo tenant(s) as soon as practicable to understand the anticipated volume of truck-to-truck cargo volume and desired allocation of functional uses within the facility. Airport planners should also consider if the tenant plans or the airport needs to use a multilevel cargo building (instead of the traditional single-level facility) because this can result in a more efficient site utilization rate since more cargo can be processed within a smaller building footprint. More detailed information is required to size and layout the site accurately.

3.2 Functional Area Space Requirements

Applying functional-area space metrics can be useful to determine the amount of space within a total site that should be allocated to achieve a balanced air cargo facility.

This can be helpful to understand if the desired or identified site is generally suitable to accommodate an air cargo facility. These metrics can support consideration of facility size and/or generalized functional area layouts to preliminarily evaluate internal and external site compatibility. The site that generally can be allocated to accommodate the three primary functional areas of an air cargo facility. The general site allocations are as follows:

- 15% for the air cargo building
- 25% for the landside
- 60% for the airside

Note that this does not apply to belly cargo facilities as those facilities do not “require” airside apron, only airside connectivity to the passenger terminal.

The subsequent sections address the various components of an air cargo facility which may or may not be familiar. As reference, Figure 3 represents a generic air cargo facility layout and identifies its individual components. The indicated dimensions are representative only and should not be considered as planning guidelines. Adjustments must be made to reflect available site size and configuration as well as the nature of the cargo.

Back to Table of Contents

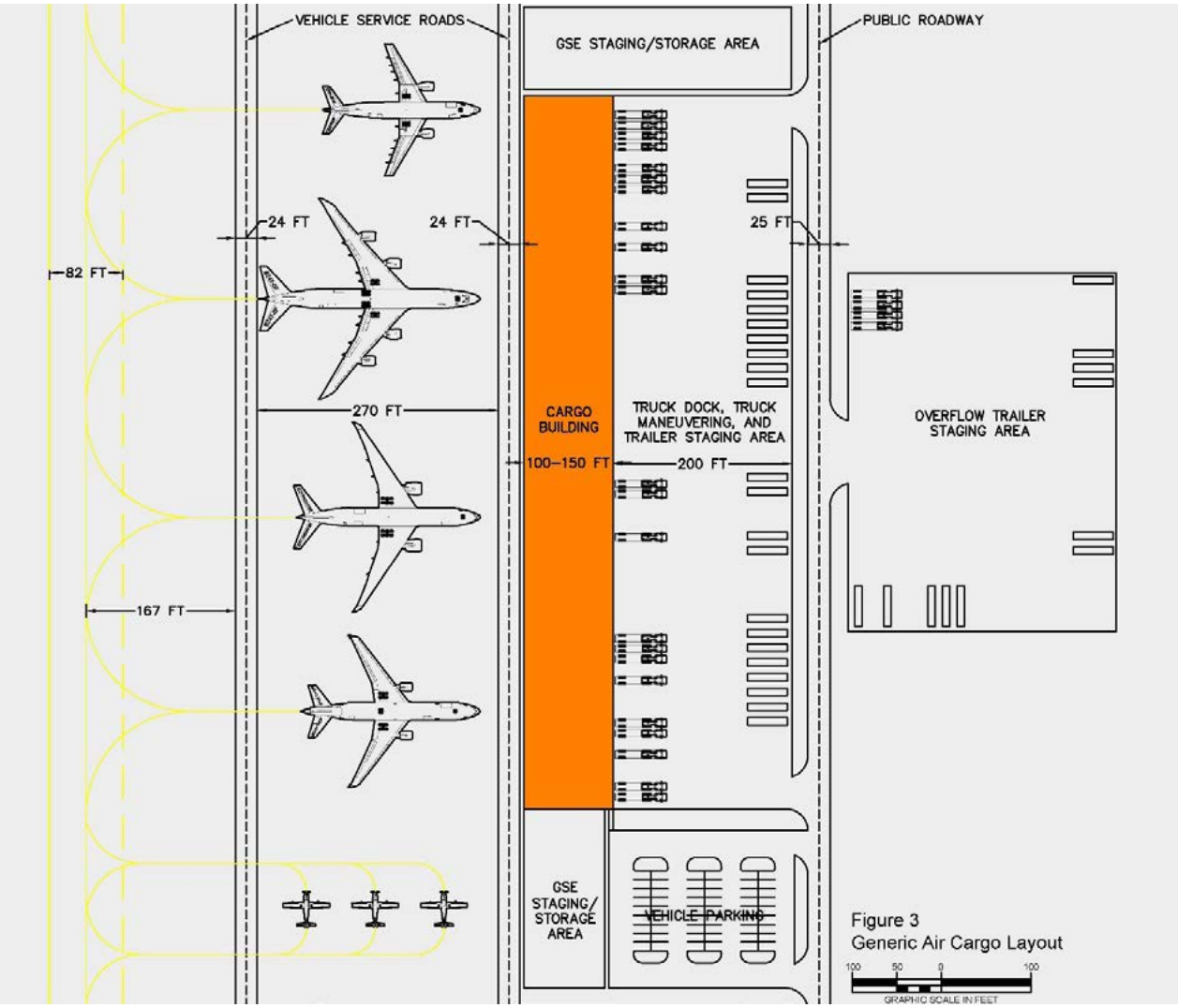


Figure 3
Generic Air Cargo Layout

3.3 Cargo Operator Type

It is important to understand common characteristics associated with the different cargo carrier types while planning air cargo facilities. Each carrier type tends to be configured differently based on the operational characteristics associated with their respective operations.

Integrated Cargo Facility Considerations

Air cargo carried exclusively on freighters by carriers specializing in providing full-service logistics operations (handling cargo from shipper to delivery points) is known as integrated cargo. Integrated cargo facilities include an apron for aircraft parking, the cargo building and landside area. The current cargo facility utilization metric ranges from one to two tons per square foot. Cargo utilization can vary from airport-to-airport and facility-to-facility for several reasons, including the nature and time sensitivity of the cargo, market share, space inefficiencies inherent in repurposed buildings, level of truck-to-truck activity, international activity or the level to which automated sortation is used.

A key characteristic of integrated cargo facilities is highly efficient operations. These facilities tend to achieve greater space and processing utilization since a single entity controls all elements of the operation; integrated cargo facilities are generally able to process larger volumes of cargo in less space.

The integrated cargo carrier category can be further classified into two subcategories based on their operational model:

- Integrated Cargo Carrier Type 1

  This operator type tends to process most, if not all, cargo on-airport, which generally results in a larger

Back to Table of Contents

on-airport facility. It may be common to achieve utilization rates such as 0.95 tons of air cargo per square foot with this operational model. *Figure 3* depicts a generalized layout of an Integrated Cargo Carrier Type 1 facility.

- Integrated Cargo Carrier Type 2

  This operator type tends to process cargo on the apron or at off-airport facilities, which generally results in a smaller building than Type 1. This operational model tends to achieve a higher level of cargo processing efficiency since relatively lower cargo volumes are processed within the building. It may be common to achieve greater utilization rates such as 1.35 tons or air cargo per square foot with this operational model. *Figure 4* depicts a generalized layout of an Integrated Cargo Carrier Type 1 facility.

These utilization ratios only consider air cargo volume. Integrated cargo carriers may also conduct truck-to-truck cargo operations at their on-airport facility which would increase the utilization rates for their facilities. Airports should coordinate with cargo operators to understand the anticipated truck-to-truck cargo volumes to more accurately size the cargo building. Space requirements for other support areas within the building (e.g. office space, storage areas and security processing space) also need to be considered. An example of high-level space planning is ten percent of the total warehouse area for office, five percent of the total floor area for storage area and five percent of the total floor area for security. In buildings of 100,000 square feet or more, the use of mezzanine office is preferred for operational and security purposes.

Freighter Cargo Facility Considerations

Freighter cargo carriers are like integrated cargo carriers because cargo is carried on all-freighter aircraft; however, freighter cargo carriers do not provide full-service logistics operations and are reliant upon ground handlers to process the cargo and potentially additional third-party companies responsible for the ground transportation. Freighter cargo facilities include an apron for aircraft parking, the cargo building and a landside area. In general, freighter cargo facilities are not as efficient, in terms of space utilization or cargo processing, when compared to integrated cargo carrier facilities.

Belly Cargo Facility Considerations

Air cargo carried on passenger aircraft is also known as belly cargo. Belly cargo facilities typically include a truck apron and docks for the loading/unloading of cargo, a warehouse and office area for the processing, break-down/buildup, inspection, storage of “held” or unprocessed cargo and a container staging area. Belly cargo is usually tugged from the passenger terminal area where the aircraft has blocked in to support the passenger operation. These facilities therefore required access to the airside and efficient connectivity to the terminal areas.

Back to Table of Contents

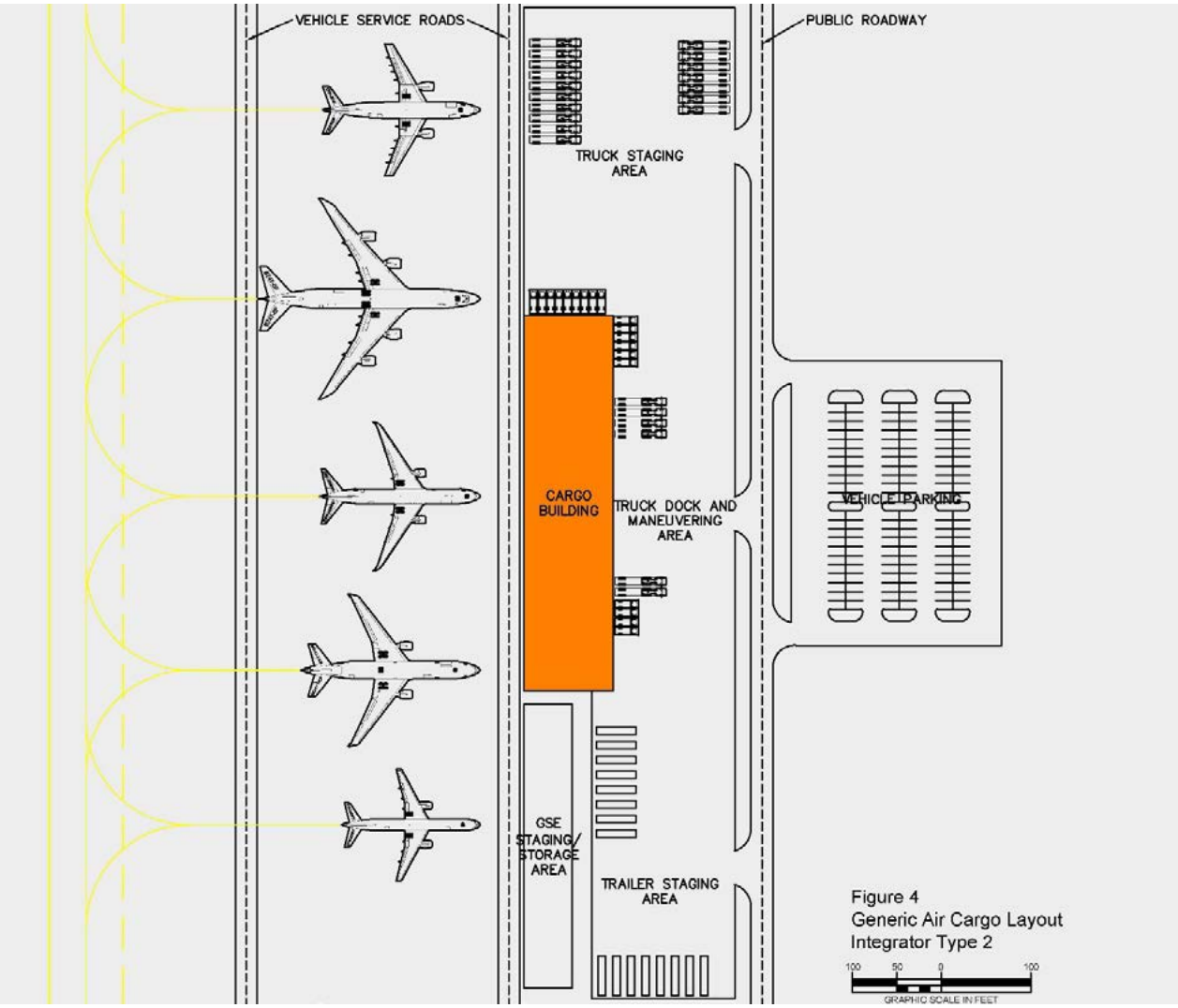


Figure 4
Generic Air Cargo Layout
Integrator Type 2

3.4 Air Cargo Buildings

There is considerable variability in the utilization rates in facilities depending on a number of factors that include, amount and type of cargo facilities needed at an airport, size of the airport, whether the airport serves as a hub (passenger or cargo), the type of cargo to be moved, the characteristics of the cargo operators, the average length of dwell time and various other factors. Utilization rates are normally measured by tonnage per square foot. Because of the frequency of flights and volumes of cargo, it is not surprising that utilization rates at smaller airports are often less than at larger airports. The average utilization rate for small airports is approximately 0.5 tons to 1.0 tons per square foot while the utilization rate at large airports is usually more than 1.0 tons per square foot. Facility planning for any airport needs to consider both the utilization rates at comparable airports and input from the carriers before determining the rate for long-term facility requirements. For general planning purposes, it is recommended that a utilization rate of one ton per square foot be used as a macro benchmark. For individual carriers, that utilization rate could widely vary. For example, a carrier that does more sortation on the ramp or off-airport could result in a utilization rate that is higher than 1 ton per square foot. Throughput will also be much greater for a facility with an automated cargo handling system. International cargo will typically have a lower throughput than domestic freight because of the custom clearance requirements.

3.5 Aircraft Parking Positions

Air cargo ramps vary considerably more in relation to cargo volumes than buildings and are a function of available land and the airport layout. Due to the variability among airports, the best approach to determining aircraft ramp requirements appears to be an average-day/peak-hour methodology. This approach to assessing capacity involves examination of the ramp chart for the most recent periods. When specific gates/

Back to Table of Contents

parking positions are not occupied, there may be time slots available to accommodate additional aircraft, depending on the ramp use strategy at the airport. Typical turnaround times at airports that do not serve as cargo hubs for cargo aircraft are normally longer than for passenger aircraft, which results in a greater requirement for parking positions.

The forecast of air cargo tonnage can sometimes serve as a basis for the projection of all-cargo hardstand position requirements. The projection uses a ratio of tonnage to departures, recognizing changes in average aircraft size and continued use of an airport's parking ramp use strategy. This ratio is assumed to increase at the same rate as the ratio between a macro forecast of revenue ton-miles and airfreight aircraft size. Both Boeing and Airbus provide these macro forecasts. Hardstand positions then are projected to increase at the same rate as the ratio of tonnage to departures.

When developing a projection of required hardstand positions, it is important to make allowances for and consider variables such as:

- Aircraft mix
- Exclusive versus common use hardstand
- Time buffers between aircraft departures and arrivals
- Use of hardstand positions by non-cargo aircraft
- Peak month activity

Use of this methodology will result in more modest growth in all-cargo hardstand positions as compared to the projected growth of building area, because it recognizes projected increases in average aircraft size and air carrier scheduling practices. Carriers tend to deploy larger aircraft into a market instead of adding aircraft. This enables carriers to link several markets together with one aircraft. Carriers may then route a dedicated aircraft into a market, as that market grows. From the airport's perspective, there may be no additional apron requirement.

The prevailing trend among all-cargo carriers is a shift toward operating larger aircraft rather than increasing fleet size.

Aircraft ramp space requirements vary based on aircraft type and should guide future ramp space planning, as defined by the FAA's Airport Reference Code (ARC):

- **Code C (e.g., Boeing 737):** ~2,300 square yards
- **Code D (e.g., Boeing 767, Airbus A300):** ~3,900 square yards
- **Code E (e.g., Boeing 747):** ~6,500 square yards
- **Code F (e.g., Boeing 747-8F):** ~8,650 square yards

Despite the move toward larger aircraft, regional feeder operations still rely heavily on smaller aircraft, such as turboprops (e.g., Cessna Caravan, Cessna SkyCourier, ATR) and narrow-body jets (e.g., Boeing 737 freighters). Airports should allocate sufficient apron space to accommodate these aircraft types where feasible.

To forecast hardstand position requirements, airport planners can use projected cargo tonnage as a baseline. This involves estimating all-cargo aircraft operations and correlating them with aircraft size, turnaround times and potential backhaul constraints.

Aircraft manufacturers suggest that revenue ton-kilometers per all-cargo aircraft will continue to rise, driven by larger aircraft and evolving cargo distribution patterns. As such, tonnage per departure is expected to increase, allowing planners to derive aircraft departure projections from tonnage forecasts. However, it's important to note that manufacturers may have commercial incentives influencing their forecasts.

Air carrier scheduling changes can also impact the relationship between aircraft operations and hardstand needs. These changes are often driven by individual airline marketing and route strategies. Therefore, it's not always accurate to assume that hardstand requirements will grow proportionally with aircraft operations.

As a general planning guideline, airports can estimate apron requirements using a ratio of 4.5 square feet of apron per one square foot of cargo building area. This includes space for aircraft marshalling and parking positions. However, this ratio should be adjusted based on the fleet mix and operational needs of current and prospective tenants.

Back to Table of Contents

3.6 Landside Effectiveness

The largest change in the air cargo industry over the past several years has been a modal shift to trucking. As such, it is important to have a set of planning parameters to measure landside effectiveness. These benchmark measures for truck docks, truck maneuvering and staging areas, employee parking, customer parking and access roadway capacity are provided below. As the balance of air and surface cargo transport continues to shift, effective landside planning now requires integrating trucking, automation, sustainability and digital management systems into every stage of facility design.

Truck Docks, Maneuvering and Staging Areas

Integrated carriers are expanding their ground networks, which entails the construction of additional surface hub or cross-dock facilities at or near strategic airport locations throughout the U.S. and Canada. Many cargo carriers in older facilities have indicated a severe shortage of truck docking facilities. Previous planning parameters indicated a requirement of 0.3 truck dock spaces per 1,000 square feet of cargo building area. Current development of cargo buildings include the doubling the number of truck dock spaces due to enhanced truck utilization and use a planning factor of 0.6 spaces per 1,000 square feet of building. This factor is an estimate and is not a substitute for obtaining more systematic data. It is imperative that the individual carrier operations are considered during this benchmarking exercise. The variability of truck operations among carriers is extensive.

The landside truck fleet ranges from the standard 53-foot-long freight tractor/trailer to smaller parcel delivery vehicles. The landside area of air cargo buildings should have the flexibility to accommodate a range of landside vehicles to support flexibility for the cargo operator. This may include provisions for accommodating the different cargo deck heights for the range of vehicles. The high utilization of smaller parcel delivery vehicles can often result in faster turnover of each truck dock resulting from faster load/unload times since each vehicle has a lower volume capacity compared to the standard freight trailer. Larger vehicle staging areas and/or more truck docks may be required to support this type of operation.

Trucks will also be getting larger. Where possible, it is recommended that future planning provide at least 150 feet from the face of the cargo building to the access roadway for truck maneuvering areas and incorporate more truck docks in the facility design. Also, the ability to stage trucks near the facility has become a necessity. As a result, additional consideration needs to be given to providing adequate truck staging and queuing areas in future designs.

Employee Parking

Greater use of automation and mechanization within cargo buildings will have a dampening effect on employee growth at airports. Typically, a minimum of two to eight employee parking spaces should be provided for every 1,000 square feet of warehouse and two to eight spaces for 1,000 square feet of office even if local building codes allow less. Where the development area is limited, alternative locations for employee parking need to be considered. This includes remote lots that utilize shuttle services and rooftop parking. Typically plan on allocating 300sf per parking position (typically nine feet wide by sixteen feet long). If space permits, these positions should be separated from the truck apron and maneuvering areas.

Customer Parking

On-airport cargo buildings are not typically high customer activity areas. Existing planning parameters indicate a requirement of 1 space per 10,000 square feet of cargo building. If the facility is broken into numerous small tenants, a higher ratio is prudent. These positions should be located away from active truck bays.

Access Roadway Capacity and Planning

Airport roadway capacity is typically evaluated using the Level of Service (LOS) methodology outlined in the *Highway Capacity Manual*. Most airport access roads are designed to meet LOS C standards, which represent stable traffic flow conditions. Under LOS C, vehicle speeds and maneuverability are moderately constrained by traffic volume, but satisfactory operating speeds can still be maintained.

Traffic projections for trucks, employees, and customers are commonly estimated using a planning ratio of 0.95 peak-hour vehicles per 1,000 square feet of cargo building space, measured in one direction. For airports with dedicated cargo access roads, a minimum of two lanes (one in each direction) is recommended, with the flexibility to expand to four lanes as demand increases.

Back to Table of Contents

Benchmarking should be applied cautiously. These estimates are most useful during early-stage planning to establish a reasonable range of expectations. However, they should not replace detailed site-specific analysis, especially when unique operational factors may influence traffic volumes and roadway design requirements.

4. Operational Considerations

Given the rapid changes common to the air cargo industry, airports are now being forced to take both an immediate and more long-term view of air cargo operational issues. These include the capabilities of air cargo facilities to meet current and future needs, the need for more air cargo infrastructure investment support for users, the provision of new and enhanced cargo processing services and the role of the airport in regional intermodal/multimodal planning and investment. While airports will be affected in varying ways and degrees by current and future changes to the air cargo industry, it is safe to conclude that the magnitude of future changes necessitates more attention on air cargo operational issues. One means is to emphasize the focus on the future is to look at the past decade and consider the significant changes that have had a large impact on airport air cargo operations. Two of the most significant are the rapid growth in the cargo-carrying capacity of airline fleets with the corresponding increase in the number of larger, wide-bodied aircraft in cargo operations and the continuing shift to trucking of domestic air cargo activity.

Express and express style carriers now account for most of the domestic air cargo activity and will require more specialized airport facilities to match their highly time-dependent processing operations.

The introduction of wide-bodied aircraft in significant numbers has driven the need for larger and more specialized airport facilities, infrastructure and services to match the carrying capacity of these aircraft. The air cargo operation for many carriers has matured to become an independent profit center and has gained greater attention within these companies. The express carriers, to an even greater extent, require more specialized airport facilities and infrastructure support to match the highly time-dependent package processing capability of their operations. These two changes have significantly influenced the investment decisions made on airports in responding to the growing air cargo industry.

There is almost universal agreement that the demand for worldwide cargo movements will continue to grow given the expansion of the global economy and the maturation of emerging global trading partners. Just-In-Time inventory management, continual marketing of new products and services, competitively priced service in relation to other transportation modes and the elevation of the logistics management function in corporate structures will be important. Continual growth in air cargo movements using passenger fleets with larger belly capacity and through a logistics system that emphasizes higher processing speed, greater efficiency, enhanced customer service and a continual effort to reduce costs, should again drive significant changes in airport cargo operations.

Some of the key operational issues that airports should consider and evaluate include:

More Specialized Air Cargo Facilities

There is a need for greater specialization in airport cargo facilities. This includes specialization that meets the individual operating needs of the carriers, cargo tenants, airport and the cargo industry will be required. Efficiencies to keep costs down while accelerating cargo processing and improving customer service will be the key. This may include the development of more sophisticated and automated facilities. Some are becoming multi-story at the larger cargo gateway airports designed to serve the needs of multiple tenants in the same facility. The airport gains in providing facilities and supporting infrastructure that conserves land, capital and building space; increases handling efficiency and lowers unit costs. The carriers and other cargo tenants benefit by having the use of a highly efficient facility that processes cargo rapidly and lowers costs due to shared facility expenses and use of the facility only as required. At some point in the future, continuing cargo growth will force the vertical development of facilities at space constrained airports.

Many air cargo operators and ground handlers have some desire to keep items cold or frozen as a means of gaining market share on specialized air shipments. This operation is often dependent on the capability of a cargo facility to store perishables in-building or within stand-alone facilities. These are specialized facilities designed to handle goods that require refrigeration such as flowers, fruits, vegetables, seafood and pharmaceutical products. They are often refrigerated or contain large coolers capable of maintaining the desired temperature. The goods are transported within special unit load devices (ULD) capable of maintaining cold temperatures during flight.

Collocated Air Cargo and Fulfillment Centers

Back to Table of Contents

In recent years, the air cargo industry has experienced a growing trend in collocating air cargo facilities with nearby fulfillment centers or on-airport when space permits. These types of facilities look and operate differently but some operators have embraced this concept to suit their operation.

The most significant difference between these two types of facilities is their function. Air cargo facilities are designed to process cargo efficiently with limited expectation that goods will remain within the building for any significant amount of time. This model differs from that of a fulfillment center which tends to function more like a storage warehouse where goods are stored onsite until such time the goods are ready for distribution. By function, fulfillment centers tend to be quite large facilities which can pose challenges in accommodating these facilities on airport.

Demand for on-airport fulfillment centers is driven by the growth of e-commerce. E-commerce is a growing market segment that increases the demand for air cargo, particularly integrated carriers. This presents several challenges for the air cargo industry and on-airport facilities (i.e., flexibility and efficiency required to transport goods to consumers within a guaranteed delivery window that is typically 48 hours or shorter). One solution is to create on-airport fulfillment centers where goods can be stored until such time it needs to be delivered regionally by ground delivery vehicle or shipped domestically (or internationally) via aircraft in response to a consumer purchase.

Based on a limited number of known new collocated air cargo and fulfillment center facilities, it is fair to assume that collocated fulfillment centers could be up to 300% larger than a traditional air cargo building. It may be possible to accommodate the fulfillment center space in a multilevel facility (e.g., above the air cargo warehouse) which could result in the same or similar building footprint as a traditional cargo building. Early coordination with the cargo/fulfillment center tenant should occur to understand how the fulfillment center can be accommodated on-airport in the most efficient manner.

On-airport fulfillment centers usually result in significantly more employees than needed to operate a standalone air cargo facility. Therefore, collocated fulfillment centers usually require larger employee parking areas. A larger work force may unduly impact the surface transportation network and adjacent land uses. Planners and airport owners should consider the possibility that implementation of a fulfillment center may require additional environmental analysis and/or traffic analysis, depending on several factors including peaking characteristics.

Air Cargo Infrastructure Support

New air cargo infrastructure that includes aircraft parking ramp, truck operating and staging area, container and ground service equipment, warehousing space and tenant/customer automobile parking will in many cases require more common use among airport tenants to ensure optimization. Greater numbers of larger capacity aircraft, operating in narrow scheduling windows at both domestic and international airports, plus separate and distinct peaking of the growing express carrier operations absorb significant amounts of capital and property to satisfy infrastructure support needs.

Enhanced Processing and Federal Inspection Services

Carriers and air cargo facility tenants in the immediate future will require enhanced processing and customer services to match the speed and efficiency of their new cargo handling operations. This may include centralized and less paper-intensive federal inspection services to clear cargo as rapidly as possible. This will require responsive fueling, deicing and ground service handling that can accommodate the scheduling requirements of the carriers as they attempt to increase the utilization of fleets that result in aircraft spending less time on the ground.

Regional Intermodal/Multimodal Planning and Investment

The need to make the entire air cargo handling operation as efficient and cost effective as possible may draw airport management into participating more in regional intermodal/multimodal planning and investment decision-making. Cargo distribution practices are currently maturing from separate and distinct multimodal functions into integrated seamless logistics pipelines. The speed, efficiency and costs of the on-airport portion of this logistics pipeline have a direct influence on the regional cargo distribution system.

Logistics Parks are a consideration for airports. Airports will need to view the air/land/sea interface of the cargo operation in a much broader regional service context with an active sharing of information between regional public and private agencies and other organizations concerning service and investment opportunities. One of the looming prospects brought on by the continual deregulation of the trucking industry will be the development and location of intermodal terminals. These will serve as regional sorting and distribution

Back to Table of Contents

centers for cargo coming from multiple locations, including the airport. The location, operation and access to the airport of such intermodal terminals may be of keen interest to airport management.

The escalating change occurring within the industry exemplifies the need to pursue flexible design and construction of cargo facilities and infrastructure. The ability to reconfigure facilities without massive redevelopment will save substantial capital investment as technology and operating procedures evolve. This should be high on the list of priorities for airports.

5. Layout Planning Issues

The dynamics of the air cargo industry, a function of industry growth and changing technology, forces the cargo facility planner to be even more innovative. Planning and design of air cargo infrastructure using current conditions as a guide assumes a static environment that does not exist. Change is constant and it must be factored into the process at every step.

The traditional single-level warehouses with truck docks on one side and aircraft parking apron on the opposite side can no longer be assumed as the standard. This analysis defines a cargo facility as encompassing a warehouse/office structure, aircraft parking apron, truck maneuvering/docking area and employee/customer vehicle parking. The industry is changing geometrically, and carriers are re-evaluating operational methods daily. A great deal of the cargo infrastructure planning and design over the past ten years has failed to recognize this constant change. The simple issue of 5-10 more feet of tail height can make a facility obsolete or less efficient in the not-too-distant future due to setback requirements.

This section identifies recent trends in the air cargo industry that have an impact on facility development and recommends changes to the standards for developing cargo facilities. For example, two evolving industry trends is multi-level air cargo buildings and buildings with landside truck docks on multiple building faces. Multi-level buildings provide flexibility for use by a single tenant or can support use by multiple tenants. Similarly, planning and designing facilities that provides truck docks on multiple faces may provide the tenant(s) more flexibility in how the facility can be operated. Some of the changes may result in the demand for additional land, which is a scarce commodity at many airports.

A first step to determining the activities that need to be accommodated, the airport must identify the potential tenants or user groups as well as their market segment and product. The target market may include passenger airlines (belly cargo), integrated carriers (small packages, overnight and just-in-time service), all-cargo carriers (medium to heavy weight goods, time sensitive and specialty items), ground handler (air-to-air, air-truck, air-sea interface), custom brokers and forwarders (e.g., IACs) and specialized handlers (perishable products, livestock and quarantine items and high security/valuable goods).

Determining the market for air cargo at a particular airport should be an ongoing exercise. A market analysis is a picture of demand at one point in time plus an informed estimate of the future trend. It is important to remember that a market analysis in a dynamic industry is almost out of date when it is completed. This is not to imply a market analysis is meaningless. Rather, the market is changing again as the final draft is being prepared. Therefore, the analysis provides a starting point.

Once a starting point is established, it will be necessary to update that information on a regular basis. The process will significantly reduce the probability an infrastructure shortage will occur at the airport. This involves, at a minimum, regular surveys of cargo carriers currently serving the airport and those not presently using the airport. This survey process is conducted at the local, regional and national levels.

The survey process is focused on the planning and operational elements of a carrier's organization. In most cases, the facility and property resources of a carrier are usually involved once a need has already been identified by the planning and operational functions.

The objective of the ongoing survey process, which can be accomplished by competent airport staff, is to ensure that not only are current carrier needs being satisfied but that future needs are addressed before those needs become problems. Regular quarterly contact with key planning and operational personnel at the local, regional and national levels will accomplish this objective and produce numerous other benefits.

Once the target markets, potential user groups, and level and type of infrastructure demand are identified, the next step in the cargo facility development process is to determine the appropriate facility or facilities. The airport must undertake a thorough analysis of existing and proposed infrastructure to support short- term and long-term master plans for the development.

Back to Table of Contents

The purpose of this section is to provide an overview of the cargo facility development process and describe ways to ensure the effective use of airport land for cargo facilities. The development process broadly covers two areas: land use issues and facilities issues. Both components can be broken further into numerous dependent subsets.

5.1 Land Use Issues

One of the most significant responsibilities of an airport operator is to ensure the effective and productive use of all airport property. In managing airport land, management must both optimize (i.e., ensure that the highest and best use of airport property is achieved through proper placement of facilities) and develop facilities in a way that most efficiently uses the available property. Unlike passenger demand, the shipper, ground handler and carriers have a great deal of influence over the flow of cargo through an airport. A well-designed cargo facility promotes the efficient flow of goods through an airport and gives an airport an advantage over competitor airports.

Development Area

The air cargo development areas should be located in airport sectors of compatible uses (i.e., industrial zones) such as aircraft and Ground Support Equipment (GSE) maintenance facilities. They must have reasonably good access to the passenger terminals and should each have sufficient area to permit long-term growth without unduly restricting the growth of the neighboring land use. The positioning of the development area should also take into consideration current and future airfield capacity requirements, allowing sufficient room to construct new runways, taxiways and ramp areas without encroaching on the cargo area. Short-term, mid-term and long-term infrastructure requirements must be considered to allow for an orderly and timely expansion of the zone.

All cargo carriers, including the integrated carriers, do not have to be located adjacent to the passenger terminal building. More important to the all-cargo carriers is good access to the regional highway system. Some integrated Type 1 Integrators will conduct their sort operation at the airport. This means that many of their on-road delivery vans and trucks enter and exit the airport several times a day, making direct access very important. The following are some general site considerations for all-cargo carriers:

- The site should have easy access to the regional highway system to include a separate access route from the terminal access system, including a separate highway interchange.
- To minimize aircraft taxi distances, the site should have direct airfield access to a primary runway. The airport is part of the team to help the carrier achieve definite delivery. Any delays, regardless of magnitude, should be considered.
- The site should not have other aviation users such as general aviation located on it. Mixing general aviation and cargo activity on a ramp creates potential for operational and safety violations and may be further constrained by future security guidelines

Since many of the integrated carriers interline (use passenger carrier lift capacity), and the freight forwarder will use both the passenger and all-cargo carriers, the ideal site is one that allows all service segments to be located together. This means identifying a site that balances the passenger carriers' desire to be located as close as possible to terminal and the all-cargo carriers' desire to be located adjacent to the regional highway system. In addition, having cargo operations located in one area will help to reduce truck traffic on the airport access system. A reduction in truck movements can have a substantial impact on emissions and ground traffic levels. The site should not be so close to the terminal that it precludes future terminal expansion options.

Site Constraints

Site constraints may include topography, line of sight, poor or unusual soil conditions, environmental contamination, proximity to land uses outside the airport which are sensitive to noise generated by the facilities and a general lack of regional infrastructure such as water supply or sewage treatment facilities. It is also possible for older, established airports to become surrounded by a community that is resistant to expansion constraining the airport (physically or politically) to a limited land inventory with which to develop new facilities. In these instances, land use efficiency is a paramount consideration.

Several construction issues impact the viability of a proposed site. The site should be relatively flat and well-drained. Earthwork should be balanced on site or balanced with earthwork requirements of other airport

Back to Table of Contents

projects. Having to import soil for a site is costly and could make potential project cost prohibitive. Utilities should be readily available to the site. Permitting requirements should be identified well before the site selection process.

Environmental mitigation is often costly and difficult to achieve; water quality and wetlands are common concerns. Both require extensive permitting before implementation. Whenever possible, environmentally "*clean*" sites should be selected. Environmental clearances are often obtained either as part of or immediately after a master plan process. Adherence to an airport master plan may reduce potential environmental impacts.

Facility Location

The nature of the business will have a significant bearing on the relative locations of facilities. Integrated and all-cargo carriers may be located in remote areas provided there is sufficient taxiway and ramp facilities to service their dedicated aircraft. Air cargo facilities require good access to the regional road network if an air-truck and/or sea-air interchange is to be a target market.

The guiding principle for locating cargo facilities is very simple: keep the cargo buildings very close to the aircraft. For the passenger airlines, this means locating their facilities near the terminal building. Airline cargo facilities require efficient access to the passenger terminal for the purpose of handling belly cargo. Tug distances have cost and other competitive implications for the carriers and tug access roadways should not cross any active taxiways. The shorter the tug distance, the later in the day a carrier can accept an outbound shipment. This competitive situation exists not only between airlines at the same airport, but also between airlines at different airports. For example, shippers close to one airport have been known to use a more remote airport because it has a later cargo acceptance time.

Compatibility of Uses and Potential Conflict

The airport must assess the complete spectrum of potential users to establish a development plan that would minimize conflicts associated with incompatible operating characteristics.

- Airline tenants that predominantly handle belly cargo would be better suited to areas closest to the passenger terminal to improve handling efficiencies of their consignments.
- Freight forwarders are generally closely associated with the airline carriers to take advantage of competitive rates offered by carriers having surplus cargo lift in their fleet. They should, however, have a secondary priority to all carriers.
- Integrated and all-cargo carriers are more independent in their operational characteristics by virtue of their fleets of dedicated aircraft. However, these aircraft require specialized infrastructure such as ramps and taxiways to support their routine activities.
- Animal care facilities may be affected by the noise generated by surrounding uses or alternatively, the facility may generate odors that are offensive to other airport users, local communities and contiguous cargo tenants.
- Custom brokers may provide services for all the above and should be located at a central location.
- For international airports, access to customs and the provision of customs facilities are important components that should be readily available to all users.

From the landside circulation perspective, it is important to create a clear distinction between vehicles destined for the passenger terminal and the vans, tractor-trailers and generally heavier vehicles servicing the air cargo complex.

Depending on the type of tenant, the requirement for airside access will vary. Ground handlers and airline tenants are generally compatible and typically do not require airside apron space in a facility. However, the aircraft ramp requirement and intense use of ground service equipment by integrated and all-cargo operators may create conflicts with the traditional cargo handlers.

5.2 Space Optimization Solutions

Efficient facility layouts tend to maximize the use of land within the given leasehold area. These are not only considerations for a land-constrained airport, but for any airport striving to achieve both efficiency and

Back to Table of Contents

effectiveness. Below are three basic solutions for this optimizing a given area of land to support an efficient air cargo operation.

Multi-level Cargo Buildings

Multi-level cargo buildings are ideal for achieving greater land use efficiency. One of the largest and most technologically advanced cargo buildings in the world is the Hong Kong Air Cargo Terminals Limited (HACTL) facility at Hong Kong International Airport (HKG). HACTL's facility is five-stories with 3.5 million square feet of floor space and 313 truck docks. Its design capacity is 3.5 million metric tons of air cargo. The building footprint of the HACTL facility is 19 acres and the total land area footprint is 42 acres.

By comparison, the HACTL facility is capable of processing approximately 95% of the 2018 total cargo volume at Memphis International Airport (MEM).

While a facility of this magnitude may not be viable for implementation at a North American airport based on height constraints and/or cost, the concept still holds true. Great land efficiency and space optimization can be achieved by constructing vertical buildings.

Multi-Tenant, Open Floorplan Facilities (Common Use Facilities)

Multi-tenant facilities with open floorplans can be used to optimize land efficiency for land constrained airports. Cargo carriers are increasingly employing third-party handlers to process cargo and operate cargo facilities on their behalf. The air cargo industry is also trending towards large, multi-level facilities that are more space efficient than traditional single-level facilities. Tenants and cargo carriers also benefit because the large multi-tenant facilities support economies of scale and consolidation benefits at an earlier point in time.

These facilities can be configured as open space without walls where cargo is processed in an efficient manner or demountable walls (i.e., partitions) to easily adjust the internal building layout and separate tenants.

These facilities are an effective option to optimize cargo processing capacity for operations that occur during differing peaks. For example, if Cargo Carrier A has peak processing times during the morning hours and Cargo Carrier B has peak processing times during the afternoon hours, this type of facility can help reduce building redundancy and maximize utilization by allowing cargo to be processed throughout the day.

These types of facilities are becoming common at all airports: the base tenant is a handling company and covers its costs through the imposition of handling fees.

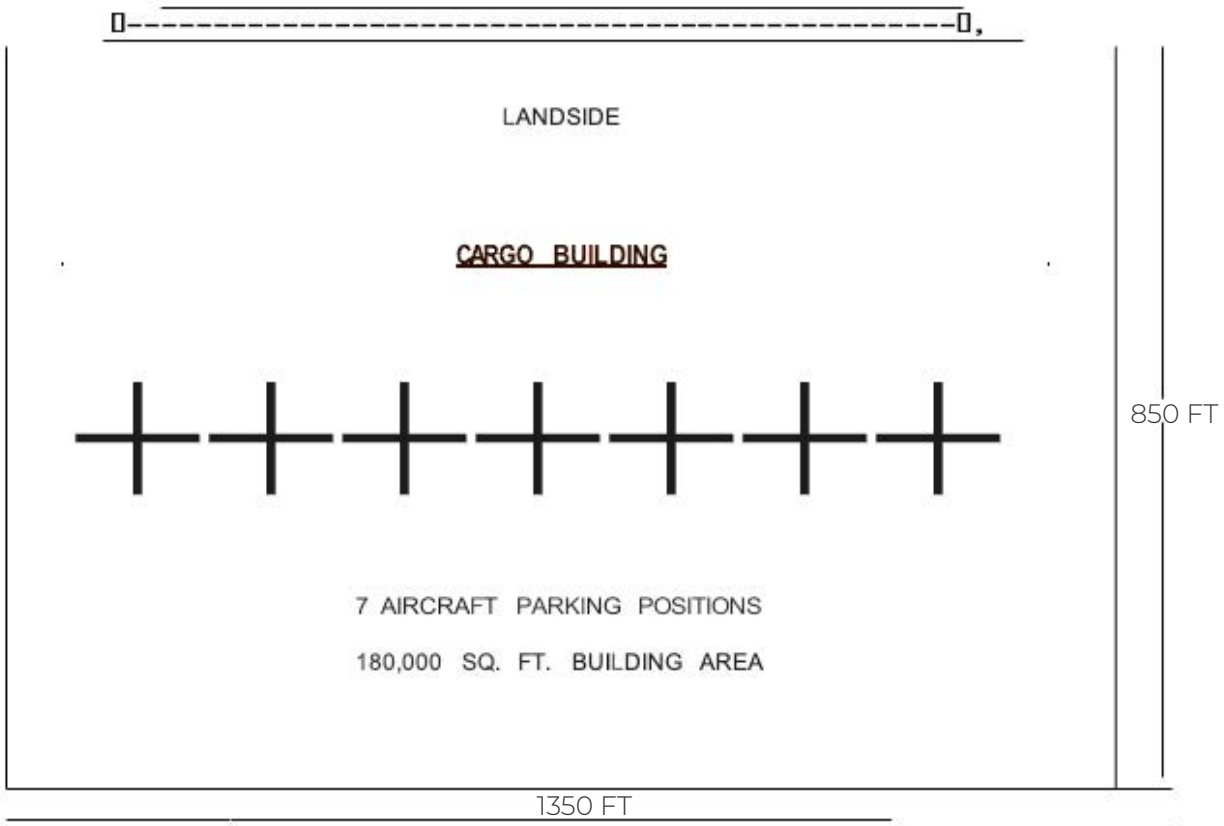
Facility Orientation

Cargo facilities can either be arranged in the traditional configuration, where the buildings and apron area are positioned parallel to the runway/taxiway system, or arranged such that buildings and apron area are positioned perpendicular to the runway/taxiway system, or some combination of the two methods. In general, a perpendicular orientation will result in a configuration that maximizes the building and apron area for a given leasehold area along the airfield frontage.

As an example, an airport has an approximately 30-acre site available for cargo facility development. Historically, the airport has developed cargo facilities in the traditional runway parallel configuration. As shown in Figure 5, if the available site is developed in the same manner, the site could accommodate 180,000 square feet of cargo building space and sufficient apron area to park seven B757 aircraft. Also, if the buildings were oriented perpendicular to the runway/taxiway system, the same site would accommodate an additional 30,000 square feet of building space and three additional B757 parking spaces. Ramp management and airside operations are more challenging but where land is scarce this becomes a solid approach.

Back to Table of Contents

Air Cargo Layout Alternatives



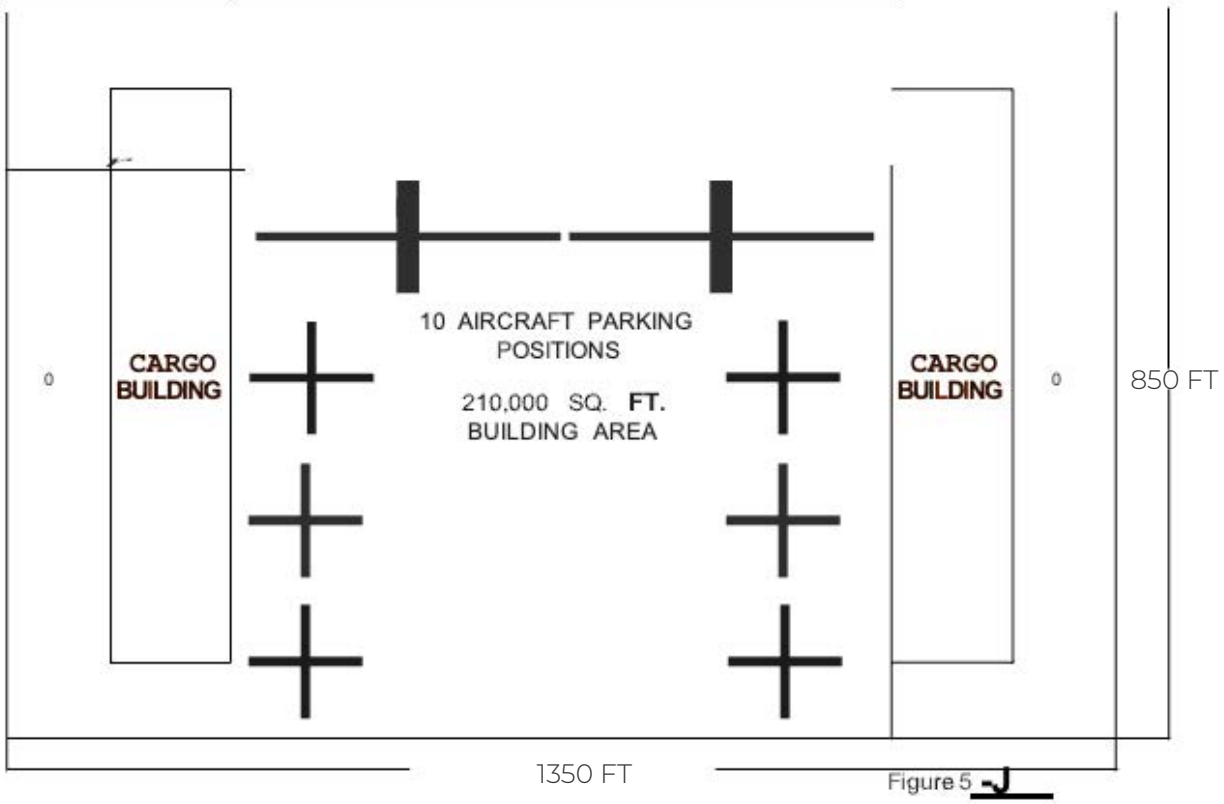


Figure 5

Back to Table of Contents

The actual design phase is probably the simplest of the entire development process. By the time the design phase is reached, the airport should have a firm grasp of the potential users, the current and future demand estimates, the available resources and development constraints. Therefore, the design phase is a creative process of harnessing ideas to a design. This does not imply the design phase is unimportant or does not require a high level of skill. Instead, it recognizes the time-consuming and labor-intensive effort needed to gather the correct information before design can be considered.

An evolving strategy is the common or shared use cargo facility. If this space is used by multiple carriers with proper scheduling, it increases the productivity of the space and reduces costs for all concerned. Staff, scales, freight equipment, loading docks and a host of other assets can be kept productive for more hours of each day. Individual carriers can reduce total space dedicated to them through this arrangement.

A driving factor in building design is the developer's desire to achieve economies of scale through the issue of repetitive modules. The tendency for tenant turnover, as well as tenant operational characteristics, requires buildings to be flexible in terms of configuration. At one time, the facilities acted more like warehouses than clearing depots and there was a strong desire by the tenants to store shipments in pallet racks. In these instances, a reasonably high, clear ceiling height was desired-on the order to 20-30 feet.

Buildings recently designed for use by all-cargo or integrated carriers have become highly specialized in nature and configuration. They are usually larger single-purpose structures having access from numerous sides. These buildings may be 100-300 feet deep (depending on sortation versus throughput focus) and 500-600 feet long in the case of large hub locations. In addition, facilities may need to be designed tall enough to consider any requirement for multi-tiered sorting devices.

Some all-cargo buildings are equipped with nose docking wings with sophisticated container handling conveyors, such that the aircraft can be parked with the cargo door adjacent to the dock, thus allowing shipments to be efficiently loaded and unloaded directly from the building to the aircraft. This is highly specialized and has only a select tenant base.

An important planning and design consideration of all-cargo and integrated carrier buildings is the relationship between the buildings and adjacent aircraft ramp and taxiways. The facility's configuration and orientation will often be driven by this relationship. The cost of constructing airside aprons, aircraft ramp and taxiways usually far exceeds the cost of constructing landside facilities such as access roads and parking lots. Consequently, the final planning and design solution will often depend on existing or proposed airside conditions.

5.3 Design Consideration

Building Dimensions and Configuration

There are no hard and fast rules regarding the dimensions and configurations of air cargo buildings. In the past, general approaches have been adopted depending on the specific user group. However, in the final analysis, the configuration of the building will depend on the operational characteristics of the user. For instance, multi-tenant airline and ground handler buildings have tended to be long, narrow structures having one of the long dimensions facing an airside apron or aircraft ramp. These buildings are in the range of 100-150 feet deep and may be up to 1,200 feet long, depending on the general airport configuration and the availability of land. There are no "rules" regarding configuration of air cargo buildings, but building orientation should optimize both airside and landside access, ensuring efficient cargo flow and vehicle maneuvering. As airports face increased spatial constraints, multi-story cargo buildings and common-use facilities are emerging as effective solutions for maximizing airfield frontage and accommodating multiple carriers under shared infrastructure.

Aircraft Handstand Positions

It is important to realize early in the airport master planning process the importance of ramp frontage. It is a limited commodity and must be used very efficiently. Those buildings which are dedicated to all-cargo, integrated carriers or any other operator with dedicated fleets of aircraft should take precedence to other operators when frontage is scarce. These users will want to maximize their frontage onto ramp areas. Conversely, passenger airline, cargo operations and ground handlers processing belly freight need very little ramp frontage but rely heavily on efficient airside access roads to the terminal.

Back to Table of Contents

Single-Access Taxilane

It is important to caution against planning air cargo facilities where two or more airlines have several aircraft parking positions accessed via a single access taxilane. This condition may result in airfield congestion. Cargo operators, especially integrated cargo carriers, want to avoid this condition. Integrated carriers tend to express greater concern from this condition since they have similar peaking characteristics which increases the likelihood of airfield congestion.

The recommendation is that eight aircraft can operate without undue delay or airfield congestion. Multiple taxilane access points or ramp control are generally recommended when the aircraft parking position count exceeds ten.

Equipment Staging Areas

There is often debate on the amount of equipment staging area that should be provided adjacent to the building. The requirement is highly dependent on the operational characteristics of the users. However, there is the tendency for "*Murphy's Law*" to prevail, whereby tenants will occupy every square foot that is allocated (or not allocated) to them and in the end, need more. There is a basic operational problem with airside equipment staging zones in that they tend to become collection areas for obsolete or broken-down equipment, as well as shipping debris that may create FOD. This is a management and leadership problem. Nevertheless, it is a design consideration.

For multi-tenant buildings, marshaling areas are often extensions of the sublease by virtue of license agreements that allow tenants to occupy aprons adjacent to their premises. The tenant gains access to the AOA via an airside service (tug) road, which is contiguous with the marshalling areas. Since many operators use the marshalling areas for breaking down and building up air shipments, it is important to consider the drainage characteristics of the area to prevent hazardous substances from entering the natural drainage system because of accidental spills within the marshalling zone.

Airside Vehicular Circulation -Tug Roads

The airside vehicular circulation network must be planned in consideration of the phasing of the air cargo complex as well as the proposed extension and additions to airfield components such as runways and taxiways. Belly cargo handlers are most affected by the efficiency of tug roads. Depending on the general airport master plan and airfield configuration, there is a potential for numerous conflicts between aircraft and GSE circulation routes. Therefore, it is important to identify these potential conflicts and address them early in the master planning process.

Planners should estimate the current and future traffic volumes, as well as the types of GSE that will be using the airside routes to ensure adequate land area is dedicated to the roadway and roads are constructed to withstand the anticipated load cycles.

Truck Docking and Maneuvering Area

These requirements will be highly dependent on the operational characteristics of the user. Since multi-tenant facilities should be planned and designed with flexibility in mind, sufficient area must be allocated on the landside of the facility to accommodate large tractor-trailer movements.

Some trucking companies require an area 150 or 200 feet wide adjacent to the building in which to maneuver rigs, depending on the frequency of movements as well as the spacing of dock doors. This large amount of truck maneuvering and queuing space often accounts for the relatively small cargo terminal facility in terms of total site requirement (i.e. floor-to-site area ratios of 20% or less). This is further aggravated by multi-tenant facility users.

An aspect that is often overlooked in the design of the cargo complex is the provision of adequate turning radii at intersections of cargo roads, as well as at the entrance to individual cargo lots. Primary access roads to various facilities within the complex must be designed in consideration of the types and volumes of vehicles servicing the facilities. It is advisable to design an average peak scenario since it can be extremely disruptive to the overall operation of the complex if remedial repairs must be undertaken to the roadway because of inadequate initial standards.

Back to Table of Contents

Employee/Customer Parking

Scarcity of land and development economics often result in design solutions whereby developing customer/employee parking areas becomes challenging. These should not be shared with landside areas that are also used for truck docking and maneuvering. This often results in circulation conflicts, especially between infrequent facility visitors unfamiliar with circulation patterns. If possible, planning and design solutions should separate customer/employee parking and truck maneuvering areas to improve the efficiency of operations and to promote safer conditions.

Access Roads

Access roads must be planned such that the long-term circulation characteristics of the complex are properly addressed. In conjunction with the conceptual subdivision plan, a system of local access, collector, and arterial roads must be identified and sufficient land area dedicated to provide efficient ingress and egress for the various types of vehicles accessing the facilities. Based on the classification of road, adequate design standards must be established to ensure uninterrupted operation for a reasonable cycle.

Future Considerations

Due to the growth of deferred express services and increasing focus on cost control in recent years, the integrated carriers are expanding their ground networks, which could entail the construction of additional surface hub or “cross-dock” facilities at strategic locations throughout the U.S and Canada (though most of these will be off airport). The biggest change in air cargo at airports may be increased integration of surface and air logistics networks.

Increased truck activity will require buildings that are much larger than would be indicated by typical planning parameters and activity records of an airport. Buildings that accommodate cross-dock activities tend to be wider to meet internal operational requirements of the carrier. Trucking will have to become more integrated within the overall air cargo activity at an airport. There must be adequate area on the landside to accommodate large volumes of truck traffic and trailer storage area. Where possible, it is recommended that the distance from the building face to building face on the landside be increased from 200 to 400 feet. An additional 200 feet would provide an area to store trailers when not in use.

A cargo operation with a large truck component should also be located such that there is relatively direct access to both the highway system and the airfield. Roadway geometrics should also consider the potential for double-and triple-trailer truck configurations.

As indicated earlier, the use of multiple story buildings will greatly increase the productivity of a given land area. In addition, automation and mechanization are becoming more common at airports as the carriers attempt to improve worker productivity. Although these state-of-the-art facilities provide significant productivity gains, they tend to require greater capital investment and be larger in terms of both height and width than the traditional one-level warehouse type cargo building. Cargo facility planning should consider the development of these types of facilities at all airports. It is recommended that future planning provide for the opportunity to accommodate buildings that are 100-300 feet wide.

After the growth in trucking, airports must consider possible increased need for aircraft ramp to accommodate the potential growth in the global freighter fleet. For established airports that are facing space constraints, this could become a serious issue that may eventually require a decision to manage aviation on a more regional basis. Depending on the airport and the region, the creation of dedicated all-cargo airports may become a much more realistic possibility than in the past. It is important however to consider the mix of potential tenants and users at a facility, the fleet mix of the carriers and how those carriers utilize belly capacity.

The air cargo industry’s transition toward decarbonization will continue to influence infrastructure planning. Future facility designs should be incorporated:

- Extensive electric charging networks for eGSE, freight trucks and passenger vehicles
- Renewable power generation and energy storage systems capable of supporting high-demand operational cycles
- Low-carbon construction materials and embodied carbon accounting in capital projects

In addition, airports are beginning to assess the infrastructure required for Sustainable Aviation Fuel (SAF)

Back to Table of Contents

logistics, including blending, storage and distribution systems that can support freight operations alongside passenger services.

FAA Design Standards

Runway clearances addressed in this section include Building Restriction Lines (BRL), aircraft parking limit lines and runway safety areas. Each of these criteria provides clearances from potential hazards for routine operations for aircraft operating on the airfield. BRL's provide the necessary clearance between buildings or other fixed objects and the runway centerline. FAA criteria for a BRL recommend that it encompasses the runway protection zones, the runway object free area, NAVAID critical areas, areas required for terminal instrument procedures and ATC tower line-of-sight. These factors should be applied to all new cargo facilities at airports.

Aircraft parking limit lines define the shortest distance that the tail of an aircraft can be to a runway, according to FAR Part 77 criteria. Aircraft parking limit lines are particularly useful in developing cargo layout concepts. A 1,060-foot limit line from the runway centerline for A380 aircraft, a 954-foot limit line for B747/B777 aircraft, a 907-foot limit line for A300 aircraft and an 808-foot limit line for B757 or smaller aircraft should be used for planning aircraft parking positions.

For larger gateway airports, where possible, taxiway requirements for runway-to-taxiway, taxiway-to-taxiway, and taxiway-to-fixed or movable objects should be based on Aircraft Design Group VI, as defined in FAA Advisory Circular (AC) 150/5300-13, *Airport Design*. Where it is not practical to provide Group VI separations, Group V standards should be implemented as a minimum.

Back to Table of Contents

Chapter 5

Financial and Management Strategies

Back to Table of Contents

Back to Table of Contents

1. Business Models

In North America, airport sponsors have four main business models for developing and operating air cargo facilities:

- Airport Development: Development and management of the property by the airport sponsor
- Tenant Development: Development and management of the property by the carrier or a handling company that subsequently occupies the facility
- Third Party Development: Development and management of the property by a third party, under contract with the airport sponsor, who subsequently leases the facility to others
- Joint Venture: Shared development and management of the property by the public and private sectors or shared development and management by a combination or consortium of air carriers

2. Airport's Goals and Objections

Financing and related management alternatives for air cargo development should be determined in the context of the airport sponsor's goals and objectives. Therefore, the airport sponsor should first determine and prioritize its specific goals and objectives. The following is a list of factors to be considered:

- Potential to Generate Discretionary Cash Flow

For airports with compensatory ratemaking methodologies, an air cargo cost center that generates net operating revenues can contribute to the airport's net cash flow, thereby providing a source of funding for other aviation improvements.

- Lowest Cost to Tenants

Under certain circumstances, airport sponsors can provide tax-exempt financing for air cargo development. Tax-exempt financing can reduce annual debt costs and is among the lowest cost financing options available. Some forms of conventional private sector financing can be structured to achieve lower annual cost for tenants than tax-exempt financing. For example, the private developer may elect to amortize the facility cost over the term of the ground lease, which is usually longer than the amortization period for the debt, to produce lower tenant rents. Also, if the private developer uses internal capital there may be greater flexibility over the length of the amortization period. The longer the amortization period, the lower the annual costs.

- Preservation of Debt Capacity

Airport sponsors that have major terminal and airfield requirements may need to preserve debt capacity for these more essential improvements, that are typically financed by airports, rely on private sector funding for cargo and other less essential development (e.g., general aviation, fuel systems, etc.). If the preservation of debt capacity is a concern to an airport, the use of debt financing should be prioritized in relation to the airport's long-term capital improvement program.

- Reduce Passenger Airline Rentals, Fees, and Charges

For airports with a residual airline rate methodology, air cargo development that generates positive net cash flow can help to reduce passenger airline rentals, fees, and charges, if cargo net revenues are applied as a credit against airline rates and charges. In addition, landing fees paid by all-cargo carriers can also offset passenger airline landing fees at both residual and compensatory airports. Air cargo net revenues can also be used to fund airport improvements, thereby reducing an airport's reliance on debt financing, resulting in lower airline costs.

- Provide opportunities for privatization

Some communities may desire to privatize some or all their airport operations (e.g. for certain political or financial reasons). Private sector development of air cargo facilities may be one way to do so while maintaining public sector control over other areas and aviation functions.

- Creation and/or Retention of Jobs in the Local Economy

One substantial impetus to air cargo development has been to create employment opportunities for the local economy. This can be accomplished by serving as a hub in a cargo or express carrier's system or by

Back to Table of Contents

simply providing sufficient capacity to accommodate the cargo demands of one's own community so businesses can expand and prosper without having the expense of trucking materials in from another nearby airport. This goal can be achieved under almost any financing scenario.

- Maintain control over land uses and facilities

An airport led development provides the greatest control over activities such as the determination of initial land uses and the flexibility to change land uses in later years in response to events or shifts in demand. If considering a third-party development, a significant amount of control in these areas may be retained with appropriate provisions and protections added to the ground lease.

- Administrative Burden

If an airport is considering air cargo development, an assessment of the related administrative burdens should be incorporated into the decision-making process. Airport staffing responsibilities for facility financing, bidding, design, construction oversight, marketing, ongoing maintenance, administration and management are greater under airport development than tenant or third-party development.

- Avoid unnecessary risks

Air cargo development can entail more financial risk for the airport sponsor than tenant or third-party development. Financial risks are determined by the local economic conditions, changing demand for air cargo facilities, technological advances, ongoing capital improvements to keep the facility competitive, industry volatility and the scarcity of air cargo facilities at the airport or competing airports.

The following matrix provides a guide for selecting a business model based on an airport's assessment and prioritization of goals and objectives. Because the joint venture model is a hybrid between the airport development and private sector models, it may provide an appropriate "middle ground" position for an airport sponsor.

Selecting a Business Model for Air Cargo Development

Goals and Objectives	Airport	Tenant	Third-party	Joint venture
Generate discretionary cash flow	X			
Lowest cost to tenants	X			
Maintain/enhance coverage	X			
Preserve debt capacity	X	X	X	X
Reduce airline rates and charges	X			
Provide opportunities for privatization		X	X	X
Create and retain jobs	X	X	X	X
Maintain control	X			
Limit airport administrative burden		X	X	
Avoid unnecessary risks		X	X	

Note: **X** denotes the model that successfully addresses the specific objective.

3. Financial Considerations

3.1 Public Sector Financing

There are three main types of tax–exempt financing available for cargo development, all of which must be issued by the airport sponsor.

- General Obligation Bonds

General Obligation (G.O.) bonds are secured by the full faith and credit of the issuing governmental entity, including the general tax revenues of the governmental entity. The debt service requirements for G.O. bonds issued to fund airport improvements are most often paid from the revenues of the airport, and not the

Back to Table of Contents

other revenues of the issuing entity. However, if airport revenues are not sufficient to pay the debt service requirements, the airport owner may be required to use its general tax revenues as a back-up source to pay the debt service requirements.

Because of the generally higher credit quality associated with this type of obligation, G.O. bonds carry the lowest interest rates of bonds. However, G.O. bond financings are usually preserved for public buildings such as passenger terminals and facilities providing broad access to an airport such as terminal ramps, runways, roadways, and parking rather than more restricted use facilities such as air cargo buildings. Air cargo buildings and ramps that serve the public by accepting and delivering cargo for shippers and consignees can be treated as public facilities (i.e., cargo terminals).

Very few large airports have outstanding G.O. bonds. At those airports, the debt in most cases was issued many years ago to fund capital improvements. However, in general, governmental entities that own small airports are more likely to make this type of bond financing available. The main advantages of G.O. bond financings are that G.O. bonds usually carry lower interest costs than revenue bonds because they are backed by the full faith and credit of the city, county or state that owns the airport; bond issuance costs are often lower with G.O. bonds than with revenue bonds because it is not necessary to develop a separate indenture or ordinance, financial feasibility study, and other legal and financial documents; and there are usually no debt service coverage requirements related to a G.O. bond issue, due to the strength of the G.O. bond credit backed by the general revenues of the city, county, or state owner of an airport.

- Revenue Bonds

Revenue bonds are the most used financing mechanism for airport capital improvements. Revenue bonds are usually secured by the revenues of the entire airport; if the airport is owned by an authority, the revenues of the authority. Revenue bonds that are secured by the revenues of an airport are usually called General Airport Revenue Bonds (GARBs). The revenue pledge for GARBs include revenues from airline rates and charges, public parking, rental car concessions and other fees, terminal concession fees, other lease revenues, and other types of revenues generated by the airport. Revenue bonds issued by an authority (such as a port authority) that owns an airport are generally secured by all revenues of the authority, including all revenues generated by the airport. Revenue bonds are more frequently used to finance multi-tenant facilities rather than exclusive use air cargo facilities.

The following past examples illustrate the use of revenue bond financing for cargo development.

- The Massachusetts Port Authority (Massport) constructed several air cargo buildings at Boston Logan International Airport (BOS), which were financed with revenue bonds secured by Massport revenues. Demand for the facilities continues to be strong given the scarcity of land and facilities at BOS. Massport adjusts the rental rates annually to recover all associated costs, including coverage on the revenue bonds.
- Allegheny County, owner and operator of Pittsburgh International Airport (PIT), issued GARBs to construct an air cargo facility for its largest airline tenant at the time: USAir. The County and USAir entered a 30-year exclusive use lease for the facility. The issuance of GARBs for the USAir cargo facility required airline Majority In-Interest (MII) approval under the terms of the airline operating agreement and terminal leases.
- The Port Authority of New York and New Jersey (PANYNJ) has issued Consolidated Bonds, which are secured by the general revenues of the Port Authority, to fund capital improvement costs at all its facilities, including its airports and the air cargo facilities at its airports.

3.2 Special Facility Bonds

Special Facility Bonds are backed by the dedicated revenue stream of the facility financed with the bonds. The types of airport facilities usually financed with special facility bonds include rental car facilities; air cargo buildings, hangars, and maintenance facilities; and passenger terminal buildings and ground equipment support facilities for the exclusive use of one or more airlines. In this type of financing, a governmental entity (usually the airport owner or a quasi-governmental entity such as an industrial development agency) typically issues the bonds and the rent revenue from the facilities is pledged for the payment of the debt service requirements.

The airport sponsor is usually not at risk if the tenant cannot make debt service payments. The rating for these bonds is based on the financial strength of the tenant or guarantees of the third-party sponsor. Because the rating is not based on the financial strength of the airport or its owner, these bonds carry a higher interest rate than revenue bonds.

Back to Table of Contents

The strength of the pledged revenue stream may vary greatly from airport to airport depending on several factors, including:

- The number and financial strength of the facility tenants
- The strength of the market for air cargo facilities
- The demand for air cargo space on airport property

At large integrator cargo hubs in Louisville Muhammad Ali International Airport (SDF) and Memphis International Airport (MEM), cargo processing facilities have been built primarily through special facility bond financing secured by UPS (SDF) and FedEx Express (MEM). However, at both airports, revenue bonds were also issued for airfield, land acquisition and other related facilities. In both instances, the revenues received from cargo carriers have contributed to the payment of debt service on the revenue bonds that financed air cargo facilities. The presence of FedEx Express at MEM has resulted in lower landing fees, partly due to the airport's cost center residual ratemaking methodology.

3.3 Other Public Sector Funds

In addition to debt financing, an airport sponsor can dedicate internally generated funds (airport discretionary cash) to cargo development as well as Airport Improvement Program (AIP) grants and Passenger Facility Charges (PFCs) to non-exclusive use cargo aprons. In accordance with the U.S. Department of Transportation (DOT) Policy on Airport Rates and Charges, an airport sponsor can recover the costs of its investment in such facilities, net of grants and PFCs.

- Airport Improvement Program (AIP) Grants

The U.S. Federal Aviation Administration (FAA) issues AIP grants to construct and maintain infrastructure projects that increase the capacity, safety and security at airports across the United States. The FAA assigns the highest priority for AIP funding to safety and security projects. The grants are issued in the form of entitlement grants and discretionary grants.

Airfield projects, including aprons and taxiways connecting aprons to the runway system, are generally eligible for AIP funding. In addition, aprons and related taxiways constructed for the use of a tenant that does not serve the public are not eligible. Aircraft rescue and firefighting buildings and buildings for storage of snow removal equipment are eligible. Passenger terminals have limited AIP eligibility. Hangars and other buildings are generally ineligible, with one exception: non-revenue producing facilities or equipment owned by an airport and used for transferring passengers, cargo or baggage between aeronautical and ground transportation modes are eligible.

If air cargo related capital improvements include airside projects such as taxiways and/or aircraft aprons, those project costs could be AIP grant eligible. Improvements, such as an aircraft parking ramp, could not be designed to serve a single tenant because then they would be considered by the FAA to be exclusive use facilities, and therefore ineligible for AIP grant funding. If an airport is contemplating significant future projects related to a passenger terminal complex and associated airfield improvements, it would not be advantageous to use AIP discretionary grant funds for cargo-related improvements, since it will likely want to preserve its AIP grant funding for eligible projects related to the passenger terminal and related airfield projects. The FAA encourages AIP cargo entitlements to be used for projects benefitting air cargo activity, and these funds could be used for airside projects to support air cargo activity, if the projects are not used by tenants on an exclusive use basis.

In summary, construction of aprons (ramps) to support new air cargo facility development would be eligible for AIP funding if the aprons are not leased on an exclusive-use basis and do not serve exclusive-use facilities.

FIX SPACING

- Passenger Facility Charges (PFCs)

Passenger Facility Charges (PFCs) are fees imposed by an airport, per enplaned passenger at commercial airports controlled by public agencies. Airports can use PFCs to pay for specific projects approved by the Federal Aviation Administration (FAA). According to federal statutes and regulations, PFC projects must:

- preserve or enhance safety, security, or capacity of the national air transportation system

Back to Table of Contents

- reduce noise or mitigate noise impacts resulting from an airport; or
- furnish opportunities for enhanced competition between or among air carriers.

In addition, to qualify for funding at the highest level, PFC projects must make a significant contribution to:

- improving air safety and security
- increasing competition among air carriers
- reducing current or anticipated congestion; or
- reducing the impact of aviation noise on people living near the Airport

An airport can use PFCs on a "Pay-as-you-Go" basis (PAYGO), it can leverage part of its PFC revenue stream, or it can do a combination of both. Leveraging PFCs can be advantageous to an airport when it has one or more PFC-eligible capital projects with significant capital outlays projected to occur during a short period of time. By issuing bonds backed by PFCs, an airport can obtain needed funding in the short term and then pay the debt service on the bonds over time as PFCs are received by the airport.

There are several ways an airport can leverage its PFC revenues:

- Bonds secured solely by PFC revenues ("stand-alone PFC bonds")
  - PFC revenues are not included in airport revenues and are dedicated for the payment of debt service on the bonds. There have not been any stand-alone PFC bonds issued in recent years.
- GARBs, with PFC revenues included in the definition of airport revenues.
  - PFC revenues are combined with other airport revenues for the purpose of paying eligible PFC debt service on the GARBs.
- PFC Bonds with a back-up pledge of general airport revenues.
  - The airport issues bonds secured by PFC revenues, with a secondary pledge of general airport revenues (often called "double barreled PFC bonds").

Depending on the scope of an air cargo project, certain components could be eligible for PFC funding. However, as noted in the subsection on AIP grants, the airport would likely want to preserve its PFC funding for airfield and passenger terminal project costs, especially considering the potential redevelopment of the passenger terminal complex and related airfield configuration.

3.4 Private Sector Financing

There are numerous private sector financing alternatives due to the variety of entities that participate in the market. There is a wide array of lending sources, including commercial banks, pension funds and insurance companies. Access to these sources is limited by the financial strength of the carrier or third-party developer seeking debt financing.

Several private firms have extensive experience in developing and leasing/managing air cargo facilities at airports. Projects included in these firms' portfolios range from the planning, construction, leasing and managing of air cargo facilities on land leased from the airport owner to the purchase and rehabilitation and/or renovation, leasing, and managing of existing air cargo facilities at airports.

A typical financing strategy for capital improvement projects will likely include the issuance of bonds by the airport owner or a development authority (usually referred to as "the Issuer"). In these types of transactions, the Issuer typically loans the bond proceeds to an entity established by the private developer (referred in this chapter as "the Company"), for the purpose of building the air cargo facilities. The Loan Agreement between the Issuer and the Company typically requires the Company to pay to the Issuer the costs associated with the bonds, including the principal and interest obligations of the bonds. The airport typically retains title of the financed facilities, and the Company enters into a Lease Agreement with the airport. The Company then subleases the air cargo facilities to various tenants. The Company's obligations under the Loan Agreement and/or Lease Agreement are payable from the rents the Company received from the air cargo facility tenants. Often, the Company's obligations under the Loan Agreement and/or Lease Agreement are secured by a mortgage given to the Issuer or a Trustee. A Ground Lease is usually executed for the land upon which the

Back to Table of Contents

project is located, pursuant to which the Company pays to the airport owner lease payments for the land.

Examples of air cargo facilities financed through bonds issued by a development authority include the following:

- Connecticut Development Authority, Industrial Development Revenue Bonds, Series 2000, for the financing of air cargo facilities developed at Bradley International Airport (BDL)
- Industrial Development Authority of the City of Kansas City, Missouri, Air Cargo Facility Senior Revenue Bonds and Air Cargo Facility Subordinate Revenue Bonds, Series 1995A and 1995B and Series 1997
- Alaska Industrial Development and Export Authority Revenue Bonds, Series 2001
- Maryland Economic Development Corporation Air Cargo Revenue Bonds, Series 1999
- New Jersey Economic Development Authority

There are several active private developers of air cargo facilities in North America. They typically compete for development opportunities through competitive solicitation processes. These private entities have developed and/or manage air cargo facilities at numerous airports including major gateways as well as small to mid-size facilities. Their diverse development experience can often bring new and creative approaches to project financing to a project.

The private financing of air cargo facilities debt can be advantageous in several ways, including the following:

- Flexibility

Often, private financing can be tailored to meet the specific objectives of a cargo development program. For example, the primary objective of an airport might be to create cargo infrastructure at the lowest possible rental rates to be competitive in the marketplace. To achieve this objective, the developer could amortize the cost of the facility over the length of the ground lease (often over multiple decades) even though the debt is financed over a shorter period, resulting in reduced rental rates for the tenants. Note that with a longer ground lease, the developer can reduce the costs that flow through to tenants and users. Also, private developers often are better able to secure short-term financings, which typically carry lower interest rates. However, the risk inherent in using short-term financings is that the private entity could be exposed to significant interest rate fluctuations.

- Expediency

In some instances, private financing can be secured more rapidly than public financing, particularly if the private entity has lines of credit already established.

- Conserve Public Capital

Use of private sector capital conserves public capital for those areas where public funding is the only alternative. To preserve resources, more airports are exploring the use of private sector funding for air cargo development.

3.5 Comparative Costs of Finance

The potential financial advantage of public sector development over other forms of cargo development is the access to tax-exempt financing at lower interest rates, particularly for GARBs and aviation facility bonds. However, public sector financing mechanisms have the following special requirements that can dilute the interest rate savings:

- A debt service reserve (equal to one year's principal and interest) and an operating reserve (usually equal to two- or three-months' operating expenses) requirement. Typically, the debt service reserve is funded from bond proceeds, thereby increasing the size of the issue. Interest earnings on the reserve while bonds are outstanding can be credited against the annual debt service and the balance can be applied against the final year debt service.
- Debt service coverage. The bond issuer is usually required to demonstrate a specified level of debt service coverage typically equal to 1.25 times annual debt service. Depending on the terms of the airport's bond indenture and airline use agreements, this coverage either (a) can be funded once (in the first year of occupancy or prior to occupancy) and then rolled over to demonstrate coverage each year or (b) may

Back to Table of Contents

have to be funded each year through cargo rentals.

3.6 Generation of Cash Flow

There are several ways for air cargo development to generate cash flow for an airport, including:

- Land rentals (valued at "historical cost" in accordance with the DOT Policy on Airport Rates and Charges)
- Recovery of debt service coverage
- Amortization charges if the cargo development is funded from airport discretionary funds. When an airport sponsor uses its own funds to construct air cargo facilities, it can recover this capital through amortization charges over the expected useful life of the facilities.
- Landing fee and ramp fee revenue from all-cargo carriers
- Percentages of vertical rent
- Percentages of service fees within the facility

3.7 Coverage Dilution/Enhancement

Compensatory airports typically need to demonstrate debt service coverage above 1.25 times to access municipal markets. Most investment bankers recommend maintaining coverage above 1.5 for these airports. Therefore, if a compensatory airport's coverage is relatively low it may not be advisable to finance cargo improvements with GARBs, particularly if cargo rentals are set to generate net revenue below the airport average coverage level (typically 1.25 times). Under these circumstances, the financing could jeopardize the credit rating of the entire airport. If so, other financing approaches such as special facility bonds, tenant or third-party financing, should be explored. Compensatory airports that fund cargo improvements with capital account monies rather than through debt issues can enhance the airport's coverage through the recovery of amortization charges.

3.8 Majority in Interest (MII) Approval

Residual cost airports typically must obtain airline Majority-In-Interest (MII) approval before proceeding with GARB-financing of cargo improvements unless the air cargo cost center is outside the airline purview. To obtain MII approval, the airport sponsor must typically demonstrate long-term lease commitments and full cost recovery (and possibly incremental revenue).

4. Risks of Development

There can be both economic and political consequences to developing air cargo facilities in a changing and dynamic market.

If a facility is developed to accommodate expected long-term demand, it is unlikely to be fully occupied immediately after construction. Vacancies could generate pressure to accept tenants under lease conditions that are less than fully favorable to the airport sponsor. For example, the airport may not be able to set rentals to fully recover all costs if market rates are lower. If the expected demand does not materialize, it could result in permanently vacant space. If air cargo facilities are developed to accommodate only near-term demand, future growth may render the facilities inadequate and result in revenue losses and dissatisfied customers.

When an airport sponsor develops a facility, it assumes these risks. When a tenant or third-party developer develops a facility, the risks are shifted from the airport sponsor in exchange for an expected profit, while the airport sponsor foregoes potential revenue to avoid the costs and risks of development.

Technology enhancements to the cargo handling process and carrier operational changes can quickly make a facility obsolete or, at a minimum, less efficient for carriers. The result is additional capital requirements to modernize the facilities.

Back to Table of Contents

5. Rating Evaluations Considerations

In analyzing debt, a rating agency looks at general operations and management procedures, capital planning and expansion projects, airport utilization trends, security provisions, environmental issues, and the service area economy, as well as the airlines serving the airport. In rating debt of airports that have a major air cargo component, the rating agency also focuses on the financial, capital, and environmental planning issues associated with the development of air cargo operations.

Air cargo development can have an overall positive effect on the airport's credit rating, if the air cargo development is anticipated to generate positive net revenues. An airport can often benefit financially through ground rents for cargo facility improvements, associated landing fees, and revenue from support functions. Revenues generated from air cargo activities at an airport can also demonstrate the diversity of the airport's revenue stream. The development of air cargo facilities can also be viewed as very positive to the extent it stimulates local and regional economic development, which strengthens the demand for, and potentially reduces the cost of air travel at the airport.

6. Cargo Facility Development Considerations

When contemplating potential air cargo development, an airport sponsor should consider the compatibility of increased cargo operations with the airport's existing facilities and passenger airline operations. This includes long-term assessments of both physical and social environmental compatibility with the surrounding community.

Airports eager to attract air cargo operators for their projected positive financial and economic impact should carefully weigh the costs considering the anticipated benefits. This includes an accurate assessment of the cost of facilities needed, the impact of cargo operations, especially express package hubs, or mini hubs on runway capacity and useful life, regional trucking activity, as well as the environmental impact of potential round-the-clock operations, and related maintenance and noise mitigation costs. Additionally, airports should look at the increased day-to-day management responsibilities and costs associated with growing cargo operations.

Other important considerations include:

- The market for air cargo facilities in the airport service area
- The availability of infrastructure to serve air cargo development or the ability to finance such infrastructure. Site and infrastructure development refers to the development of areas such as airfield aprons, roadways, utilities, telecommunications and common parking. Infrastructure may also include container freight stations, ramp level offices with easy access to the airside, as well as road or rail access for ground distribution. Infrastructure also includes customs clearance capabilities for international cargo. Improvements such as cargo community systems (CCS) to provide visibility and real-time tracking are becoming more common. If it is not already in place, these components could prove very costly for the airport to develop.

Approaches to site and infrastructure development vary widely depending on factors such as the philosophy of capital investment, the availability of land and capital, the extent of existing development, and the approach to cost recovery. Airports that wish to minimize risk tend to leave infrastructure development to the tenant or third-party developer. Airports that wish to maximize flexibility and control tend to provide infrastructure development. The costs of infrastructure, other than aircraft aprons, are typically recovered through ground rents. The costs of the apron are usually recovered through aircraft parking fees. Air cargo buildings with direct access to aircraft aprons typically have higher rental rates, reflecting the benefit of this access.

- Compatibility of cargo operations with other airport uses and the surrounding community. Traditional air cargo moves at night and potentially has higher noise impacts in residential areas than do daytime operations. Express cargo tends to move at the end of the business day, and this may complement an airport's role as a passenger hub. However, express cargo carriers may compete with passenger airlines and strain runway capacity, as well as ramp and road access, especially at major package sorting hubs. Levels of service on accessing roadways should also be carefully considered.
- The revenue pledge securing, supporting the debt and the financial resources of the tenants.

Back to Table of Contents

7. Pricing of Air Cargo Facilities

7.1 Rate Base Elements

Costs that can be included in the rental rate base for air cargo facilities include:

- Debt service (and required coverage if applicable)
- Land rental (based on historical cost, net of grants and PFCs)
- Direct operating expenses (maintenance, repairs, insurance, cleaning, common area costs, etc.)
- Allocable indirect operating expenses (administration, aircraft rescue and firefighting (ARFF), roadway, security, utilities, insurance, etc.)
- Infrastructure necessary to support the facility (tug roads, access roads, cargo ramps, employee and truck parking, equipment storage areas, fuel systems, deicing facilities, apron lighting, etc.)

There are four types of rentals and fees typically charged for air cargo facilities:

- Building rentals to recover capital and operating costs associated with the cargo building, including allocable indirect operating costs.
- Utility costs if not directly billed by the utility company.
- Ground rentals to recover site and infrastructure costs, including truck docks and public vehicular parking areas.
- Apron fees to recover the costs of the cargo apron if not included in the landing fee rate base.

7.2 DOT Policy on Airport Rates and Charges

DOT and FAA policy on airport rates and charges differentiate between the airfield, other aeronautical facilities and non-aeronautical facilities owned by an airport. For the airfield (runways, taxiways and cargo aprons), airport sponsors are limited to recovering historic costs for aeronautical use. Aeronautical uses include “services provided by air carriers related directly and substantially to the movement of passengers, baggage, mail and cargo. Persons, whether individuals or businesses, engaged in aeronautical uses involving the operation of aircraft, are considered aeronautical users. For other aeronautical facilities, fees may be set based on market rates, rather than historic costs. For non-aeronautical facilities, airports must set fees based on market rates.

The distinction between the airfield and other aeronautical facilities was originally an element of the FAA and DOT Airport Rates and Charges Policy adopted in 1996. A court decision held that DOT had not adequately justified the distinction and ordered it vacated. Through a series of decisions on individual disputes over airport fees, DOT has restored the distinction, as reflected in the FAA’s Airport Compliance Manual, Order 5190.6B (2009).

Many airport sponsors in North America price air cargo facilities (building rentals, apron fees, ground rentals, truck dock and employee parking fees, etc.) based on market rates rather than historical cost, particularly for older facilities, which are fully amortized or nearly fully amortized. In fact, third party or private operators typically price air cargo facilities based on what the market will accept. Therefore, private operators will not be constrained by the Policy while airport sponsors who develop or operate air cargo facilities will be required to comply with the new pricing restrictions.

As a practical matter, the policy will constrain airport sponsors in setting rates only for cargo aprons and taxiways used to access air cargo facilities. For other facilities, airport sponsors can (or must) use a fair market value basis. The DOT policy also provides that the progressive accumulation of substantial amounts of surplus aeronautical revenue may trigger an inquiry into whether the sponsors rates and charges are consistent with the reasonableness requirement. The DOT policy does not preclude generation of any surpluses and explicitly recognizes the need for airports to finance capital, as well as operating costs.

In addition, airport sponsors are subject to restrictions on the use of airport revenue. Airport revenue may only be used for the capital or operating costs of the airport, the local airport system or other facilities directly and substantially related to air transportation. This requirement means that although an airport sponsor

Back to Table of Contents

can generate surplus revenue (revenue more than its operating costs), it can do so only to the extent that the surplus revenue is needed for current or future capital investment needs at the airport, the local airport system or other facilities directly and substantially related to air transportation. The policies on rates and charges and revenue use do not define precisely the extent to which airports may generate and hold surplus revenue in anticipation of future capital needs.

Taken together, the two policies can discourage an airport sponsor from developing air cargo facilities on their own to enhance revenues and thereby generate surplus revenue. These restrictions apply even if a private developer generates profits and an airport sponsor participates in some of those profits. Third party developers typically are not in the business of transporting cargo or freight, and therefore, the development would be considered non-aeronautical. Thus, the fees charged by the sponsor, including any share of the developer's revenue or profits, could be based on fair market value. However, any revenue earned by the sponsor from the third-party development would be considered airport revenue, which is subject to the revenue use restrictions, and such revenue might be considered by the FAA in evaluating whether the airport sponsor was generating excess surplus revenue.

8. Development timeline/impact on schedule

The development of facilities by an airport sponsor usually requires more time than private development. Preparation and negotiation of a lease with a tenant or third-party developer can take six months or longer for airports that have no prior experience in such transactions but can take less time for airports where the sponsor has prior experience. Leases to tenant or third-party developers (and sometimes attendant Development Agreements) are usually considerably longer and include detailed plans for development and use of the land. Therefore, the lease should contain the standard provisions of a tenant lease, plus a full range of additional provisions such as:

- Facility design and construction
- Reversion of facilities to the airport sponsor
- Buyout of the remaining leasehold by the airport sponsor
- Development and performance standards

The airport sponsor should also carefully research the development background, financial strength (capital, net assets, credit rating), and references of the specific developer given the long-term nature of the lease.

On the other hand, preparing and negotiating a lease under airport development usually has little effect on the development schedule and is less complicated. In addition, tenant and third-party leases must be negotiated before development can begin, while airport development can occur in parallel with construction if the airport is willing to take the risk that negotiations will be successful. The additional time required for implementing tenant or third-party development includes allowances for a competitive selection process if required.

It often takes longer to bid and design a facility under airport development than under private development. This is due to the time required to follow government procurement procedures. The magnitude of the time difference depends on the length of the airport's procurement process and the experience of the private entity. Time savings can be made if a tenant or third party uses a design-build process. Constructing the facility usually takes the same amount of time under each model.

9. Control of Land Use and Facilities

9.1 Land Use

An airport retains the most control over land uses occurring on property that it develops the authority to determine initial land uses and the flexibility to change land uses in later years in response to events or shifts in demand. Under tenant or third-party development, an airport's control of land uses is frozen for the term of the lease unless appropriate protections are incorporated into the ground lease. Initial uses are set by the terms of the lease, but the airport loses its flexibility without proper ground lease provisions to change land uses in later years as necessary.

Specifying allowed and prohibited uses in the ground lease is essential to maintaining control of the use of

Back to Table of Contents

airport land.

9.2 Lease Term

Tenant and third-party developers usually require long-term leases to finance and/or amortize their investment. In the case of long-term leases, the airport sponsor should include a buyout option, so the use of the land is not frozen for the term of the lease. However, buyouts often require a substantial cash outlay to regain control of the land.

Most airport land leases, including land leases for air cargo facilities, contain a clause providing that the leasehold improvements (buildings and other facilities constructed by the lessee/developer on the leased land) will transition (revert) to the landlord (the airport owner). Therefore, the length of the lease term is an important consideration for any private entity considering whether to enter a land lease with the intent of constructing improvements on the land. The private entity will have to depreciate the full value of the improvements over the term of the lease. Therefore, the term of a lease must be long enough to enable the private developer to amortize or depreciate its capital investment.

A review of recent business deals for air cargo facilities at airports indicates that a lease term of 25 to 30 years is common. However, it is not uncommon for a developer to seek a longer lease term in consideration for a better financial deal for the airport. For example, a developer often proposes a longer lease term in consideration for a greater financial return to the airport. It is noted that due to concerns about the potential short lease term for cargo facility development at John F. Kennedy International Airport (JFK), the lease documents provided that in the event the Port Authority's Master Lease with the City was not extended prior to expiration, the City would enter into a lease with the developer to extend the air cargo facility lease for an additional thirteen (13) years so that the air cargo facility could continue to operate. This was considered by the developer to be a critical provision to realize a reasonable return on its investment.

The issue of lease term length for cargo facility development has also been effectively addressed through the creative use of lease extension options. For example, Ted Stevens Anchorage International Airport (ANC) negotiated a lease agreement for the development of a cargo facility on a 20-acre parcel of land. The lease term was 35 years, with four options to extend the lease, each option being five years, thereby resulting in a potential lease term of 55 years.

A creative approach to the challenges related to the reversion of leasehold improvements was implemented by the Monroe County Airport in Bloomington, Illinois (BMG). BMG negotiated a land lease with a private entity, which agreed to develop a 29,000 square foot hangar complex, which was completed in 1994. The lease has a 20-year term, with a 10-year option for renewal, after which the hangar complex will revert to BMG. However, the lease allows the tenant to retain a portion of ownership in the facility. BMG becomes vested in the facility at a rate of 2.5 percent per year. This means that at the end of 30 years (assuming the 10- year renewal option is exercised), the tenant will own at least 25 percent of the facility. BMG has since used this lease structure to attract other types of development, including a flight training center with seven offices, which was constructed in 1998, and a corporate flight complex, which was constructed in 2000.

Because most leases provide for the reversion of leasehold improvements to the airport at the end of the lease term, it is desirable (for the airport) to include in the lease clear provisions regarding required facility upkeep and reversion requirements. Otherwise, the lessee may have limited incentive to perform maintenance and upkeep on the facilities during the term of the lease. The airport owner should ensure that the lease provides cure provisions for problems and enables the airport owner or its representative to enforce required maintenance and upkeep schedules and standards.

9.3 Ground Rent During Construction

Normally, a land lease that involves the development of air cargo or other facilities will specify a certain period during which the construction of the facilities must be conducted. To be effective, the lease should provide for the termination of the lease if the facility has not been constructed within the specified period. This protects the airport owner from having land tied up under a ground lease for extended periods, without any facilities being developed.

From the developer's perspective, the land rent during construction should be at a reduced rate or waived altogether. The developers argue that such a provision enhances the financial viability of the project because it reduces their cash outlay during construction and increases their return on investment. Perhaps more importantly it reduces the costs that eventually flow through to the tenant.

Back to Table of Contents

9.4 Competition With Existing Facilities

An excess of similar facilities at an airport will have the effect of diluting the demand for those types of facilities. Private developers of air cargo facilities, for example, have an interest in ensuring that there will not be excess air cargo facilities at the same airport that will compete with the new facilities to attract tenants. This can be problematic, particularly if there are other air cargo facilities at the airport that are older and command lower rental rates. Some tenants would prefer to rent the older facilities, even if they are less efficient from an operational standpoint, if the rent is substantially less than the newly developed facilities. This type of situation can undercut the rent producing potential of the new facilities and will negatively affect the developer's return on investment (and incentive to build). The creation of joint marketing agreements can mitigate some of these concerns.

9.5 Facility Use and Maintenance

An airport often has less control over the management and maintenance of privately developed facilities, compared to facilities developed by the airport. Therefore, it is important that specific standards be included in the agreement with the private developer and operator. In the case of privately managed air cargo facilities, the airport sponsor must work through the developer rather than directly with the tenants. However, in a multi-tenant facility it may be easier to coordinate through a developer than with a multitude of small tenants.

For all air cargo facilities, whether developed and operated privately or publicly, the legal agreements should include strict provisions regarding the handling of hazardous substances and compliance with rules, regulations and local codes, including financial penalties. This is particularly important in obtaining compliance with local environmental rules and regulations and holding parties responsible for the costs of environmental remediation.

9.6 Tenancies

An airport sponsor's control of tenancies depends on the lease provisions negotiated and the degree to which this control is exercised. Approval of sub-tenancies by the airport sponsor should be part of the standard lease in facilities that the sponsor develops as well as those developed by tenants and third-party developers. Any such agreement should address the potential for a percentage of revenue sharing for the airport above a certain threshold.

9.7 Facility Design

An airport sponsor can control the design of a facility developed by a tenant or third party as closely as a facility it develops if it imposes stringent lease provisions, reviews the developer's design carefully and enforces its design standards. The ground lease should include provisions on formal design guidelines, regular construction inspection, and approvals of all designs and modifications.

9.8 Guidelines for Airport Control of Commercial Rights

The following provisions are recommended to preserve the rights of an airport to direct and influence the commercial aspects of its air cargo program.

1. The right to develop air cargo facilities on the airport should be non-exclusive; unless there are extraordinary reasons, no third-party (airline or developer) should be granted exclusive control to develop or lease the entire or most of the inventory of an airport's air cargo facilities. The airport should maintain its option to either develop or lease air cargo facilities itself and/or to award the right to a series of third parties to develop air cargo facilities on a non-exclusive basis.
2. The airport should maintain a market based rental structure in its leases for on-airport air cargo facilities to either generate discretionary revenues under its airport operating agreement with the passenger airlines, if possible, and/or to maintain the financial viability for third-party developers to develop and lease air cargo facilities (i.e., a cost based rental structure may preclude the option of attracting a third-party developer to develop and lease air cargo facilities).
3. The airport should control the rate of commercial development to maintain market rates by timing the development or redevelopment of air cargo facilities to minimize a shortage or excess of vacant facilities

Back to Table of Contents

and air cargo space.

4. The airport should establish and maintain the right to approve the rental rate structure charged by tenants of third-party controlled facilities to ensure that discounting or artificially lower rates are not permitted that erode an airport's market rental structure. Rates should be comparable for like type facilities (e.g., age, size, utility, location, etc.)

5. The airport must control commercial access to the airfield ramps to ensure off-airport cargo tenants are not able to bypass the on-airport air cargo facilities and deliver cargo directly to aircraft. Permitting such an activity by off-airport tenants may erode both the market rental structure and the financial viability of on-airport air cargo facilities. In other words, the on-airport tenants have paid a premium for direct access to aircraft while the off-airport tenants have not.

6. As the airport gains title to and control of third-party developed facilities at the expiration of the developer's lease with the airport, the term of that lease and financial offer made by the developer should be linked, perhaps as a bid item in the airport's solicitation, to optimize the best financial return for the airport over the shortest period. As the airport stands to gain significantly increased revenues when it assumes title and control of these facilities (assuming they were well maintained), the term of the original developer lease needs to be linked directly with the developer's final offer (i.e., lease terms of 30 to 40 years should not be granted without quantified financial benefit).

7. The airport should establish and maintain the right of advanced approval of all tenant leases in third-party developed facilities and the activity to be conducted under the lease. All rights of such tenant leases should be subordinate to the lease between the airport and the developer.

8. The tenant activities on the air cargo facility premises should be limited to the handling, storage, distribution, and forwarding of air cargo goods or activities expressly authorized by the airport such as fueling, ground handling, and/or servicing of cargo aircraft, subject to the airport's rules and regulations. No other commercial activities should be permitted without the written approval of the airport. The lease between the airport and the developer should obligate the developer to enforce these provisions on its own premises and allow the airport to audit at their discretion.

9. The lease or use of aircraft parking space should have a direct relationship with any adjacent cargo building space and such aircraft ramps should be made available on either a common use or preferential use basis and not on an exclusive use basis. Essentially granting a lease of apron space for non-tenant aircraft may harm the marketing of space in the building if a new tenant requires both building space and an aircraft parking position. Common or preferential aircraft parking provisions provide far greater flexibility to the airport in the use of this expensive and scarce resource and yet can be fashioned to support the needs of building tenants first (i.e., no storage of out of service aircraft or equipment).

10. The airport should guarantee access to tenants or developer-controlled aircraft ramps, without charge, to parties under contract to the airport to fuel and service aircraft or handle the air cargo of airport tenants, provided such parties have insurance acceptable to the airport and proper indemnifications have been provided.

11. The airport should establish and maintain its right to approve all assignments and leasehold mortgages in advance. The assignment or sale of a developer or tenant lease should be contingent on requiring the successor to be bound by all the terms and conditions of the lease, require the conclusion of satisfactory negotiations with the airport, if necessary, and require some financial test of fitness.

10. Common use – an evolving concept

Increases in air cargo volumes due to e-commerce operations have changed the goods movement landscape and forecasts continue to indicate robust growth. Capacity at many airports will be challenged as consumer demand for next-day delivery and global reach expands. To optimize throughput in a cargo building, the model of a common-use facility is becoming more prevalent. Under this concept the facility is developed or operated by a single entity and handles multiple clients on a fee for services basis. This differs from a multi-tenant facility in which different users have small leaseholds in the building. The single managing entity and elimination of internal separations for tenants creates a more efficient operation, increasing staff and equipment productivity and extending the life of the facility.

Airports can improve their chances of handling high value verticals such as e-commerce and perishables by developing specialized nonaligned facilities with services available to all carriers and forwarders. Leading

Back to Table of Contents

enticements to stakeholders are:

- Specialized facilities equipped to handle high value verticals
- Automated common use freight terminals
- Integrator facilities
- Availability of high-quality cargo handling services
- Truck marshalling/slot management system
- Ample freighter parking
- Hydrant fueling
- Cargo community systems to link stakeholder information
- On-site CBP facility
- Access to highway systems

11. Airport Staffing Requirements

Airport staffing to handle financing, bidding, design, construction oversight, marketing, management, administration and maintenance is greater under airport development than under tenant and third-party development. The number of staff needed depends on:

- the number and type (single tenant versus multi- tenant versus common use) of facilities developed
- whether the airport has a policy of constructing the types of building to expedite design and review processes
- the condition of existing infrastructure
- the amount of work performed by others under contract

There are three categories of staffing requirements:

1. Tasks performed by airport sponsors regardless of who develops the property:
   - Design review and approval (initial construction and ongoing modifications)
   - Construction oversight
   - Lease development and negotiation (ground lease if tenant third party, tenant leases if airport developed)
   - Monitoring of leased sites
   - Revenue and cost accounting (for ground lease if third party developed or for all tenant leases if airport developed)
2. Tasks performed only if airport sponsor develops the property. If a tenant or third-party develops the facility, they perform these tasks:
   - Solicitation and review of construction proposals
   - Financing
   - Insuring functions
   - Marketing
   - Leasing
   - Facility operations and maintenance and related accounting functions
   - Tenant billing and collections
   - Capital improvements (scheduled and unscheduled)
3. Tasks performed only if tenant or third-party develops the property
   - Solicitation and review of development proposals if a competitive bid scenario is required

Back to Table of Contents

12. Standard Lease Terms and Conditions

The following standard lease terms and conditions should be included in air cargo facility leases:

- Facility design, construction and use of demised premises
- Activities permitted/prohibited/required (on land/buildings)
- Rental rate/rate base elements (procedures for adjusting)
- Ramp use and management (as appropriate)
- Payment provisions
- Subleasing/assignment
- Nondiscrimination
- Airport sponsor access and rights to inspection
- Taxes and licenses
- Improvements and alterations
- Reversion of facilities to airport sponsor (condition)
- Lease buyout
- Indemnity (airport held harmless)
- Insurance requirements
- Signage
- Ownership and maintenance of improvements
- Maintenance of demised premises
- Restrictions and regulations
- Default and termination
- Cure provisions
- Attorney's fees
- Hazardous and other regulated substances
- Airfield security
- Business tax registration
- Disabled access
- Section 308 exclusivity
- Rights of United States government
- War and national emergency
- Other agreements not affected
- Notices

Each airport typically has its own specific contract language that addresses these and other airport-specific provisions.

Back to Table of Contents

Chapter 6

Bilateral and Regulatory Issues Facing the Air Cargo Industry

Back to Table of Contents

1. Regulatory Constraints Facing the Cargo Sector

1.1 Bilateral Air Service Agreements

International aviation is governed by an array of bilateral agreements and some multilateral agreements between and among governments that have evolved under the framework of the Chicago Convention of 1944. Since 1992, the United States has been pursuing an Open Skies policy. The main components of an Open Skies agreement are:

- Open international routes between the parties including third, fourth, fifth and sixth freedom traffic rights
- No limits on number of carriers that are allowed to operate
- No limits on the number of flights they can operate
- Liberal provisions on pricing and charters
- Provisions on commercial opportunities (e.g. intermodal rights) and doing business issues (e.g. user charges and ground handling)

The United States also has optional provisions with respect to cargo that it seeks from its negotiating partners: intermodal code sharing and seventh freedom traffic rights for all-cargo scheduled and charter services (e.g. seventh freedom traffic rights allow an airline to carry traffic between two countries neither of which is its homeland [for example: e.g. Lufthansa carries cargo between the United States and India without landing in Germany]). The consent of the third country is necessary before the rights can be implemented.

The United States has also been successful in concluding Open Skies agreements with many countries in every region of the world, numbering more than 100 Open Skies partners since 2010. Over half of these agreements include seventh freedom traffic rights for all-cargo services and the U.S. Federal Government has made a concerted effort to revisit existing Open Skies agreements to add all-cargo seventh freedom traffic rights. All U.S. Open Skies agreements cover all-cargo services. In a few cases, such as in Asia, U.S. partners have agreed to Open Skies for all-cargo services only.

Most of these Open Skies agreements are bilateral agreements. However, the United States has two multilateral agreements:

- United States/European Union Air Transport Agreement and
- Multilateral Agreement on Liberalization of International Air Transportation (MALIAT) which was started in 2001 and which primarily involves partners surrounding the Pacific Ocean: Brunei, Chile, Cook Islands, Fiji, New Zealand, Samoa, Singapore, Tonga and the United States. The MALIAT also provides an option which allows countries to accede to a Protocol for Open Skies for all-cargo services only. Mongolia opted to agree to the all-cargo Protocol.

Some of the air transport agreements reached with major aviation partners since the 2005 issue of the ACI-NA Air Cargo Guide, such as the European Union, Brazil, China, Colombia and Japan. These are discussed below:

U.S./European Union Agreement

The United States and the European Union reached an Open Skies Agreement (Stage 1) in 2007 and concluded negotiations on amending the Agreement in 2010 (Stage 2). The Agreement governs aviation relations with the EU and its 27 Member States. Iceland and Norway have acceded to the U.S./EU Agreement even though they are not members of the EU. The Agreement extended Open Skies to EU member states that did not have such bilateral agreements with the United States, such as the United Kingdom.

The U.S./EU Agreement also includes some seventh freedom rights for all-cargo services. The EU airlines have open seventh freedom rights for all-cargo services between the United States and other countries. U.S. airlines are limited to those seventh freedom traffic all-cargo rights, which they already had under bilateral agreements with some Member States, such as France and Germany.

The U.S./EU Agreement is sometimes referred to as Open Skies plus because it contains additional liberalizing elements. For example, the United States agreed to the “EU carrier concept” which means the

Back to Table of Contents

United States would accept any EU airline substantially owned and effectively controlled by nationals of any EU Member State or States to operate between any point in the EU (not just that airline's homeland) and the United States.

The Agreement also allows EU airlines to carry Fly America civilian government scheduled and charter cargo and passenger traffic in international markets that do not include the United States and in U.S international markets for which there is no General Services Administration contract. It provides that U.S. airlines can enter into arrangements for aircraft with crew for international air services that do not include the United States; previously, U.S. airlines were not allowed to wet lease from foreign carriers in any markets. The Agreement includes an emphasis on enhanced cooperation between the United States and EU on a variety of issues.

The Agreement also details how the International Civil Aviation Organization (ICAO) balanced approach to aircraft noise management at airports should be implemented. The balanced approach requires a careful evaluation of costs and benefits before restrictions can be placed on aircraft operations. U.S. cargo carriers are concerned about EU airports proposing and implementing noise-based operating restrictions as these undercut the economics of their operations.

There are additional rights available to each party, but they are subject in the case of the United States to changing its law on U.S. airline ownership and control and in the case of the EU to changing its law on airport noise restrictions. For example, if the United States were to liberalize its law to allow majority ownership and effective control of U.S. airlines by EU nationals, then U.S. airlines would receive open seventh freedom rights for all-cargo services between the EU and other countries among other things.

U.S./Brazil Agreement

The United States and Brazil initialed a phased Open Skies Agreement during late 2010, which eventually entered into force in May 2019. The agreement includes unlimited number of carriers, open international routes, code sharing, pricing, and charters. However, the Open Skies agreement did not include seventh freedom traffic rights for all-cargo services, but the U.S. has approached the Brazilians about implementing these rights.

U.S./Colombia Agreement

Also in late 2010, the United States and Colombia reached a phased Open Skies agreement. Most of the Open Skies provisions applied immediately to all-cargo services. With the phasing completed at the end of 2012, full Open Skies for combination and all-cargo services is in effect. However, the Open Skies agreement does not include seventh freedom traffic rights for all-cargo services although the U.S. has approached the Colombian government about adding these rights.

U.S./China Agreement

Over the years, the United States and China have gradually liberalized their aviation relationship, with the major exception of the 2020-22 COVID-19 Pandemic as a more restrictive period. In May 2007, the U.S. and China reached an agreement which substantially expanded rights for both sides. The provisions governing all-cargo services are more liberal than those on combination services. Effective March 2011, the agreement provides for unlimited designations, frequencies and open international routes including fifth freedom and sixth freedom rights for all-cargo services. Special provisions continue to provide seventh freedom traffic rights and enhanced change of gauge rights for a carrier which operates a cargo hub in the other country meeting the requirements stipulated in the Agreement. However, cargo charters like combination charters are generally subject to quotas in city-pair markets in which Chinese carriers operate scheduled all-cargo services except for charters involving China's Zone 3 as defined in the Agreement.

The Agreement continues to apply designation limits (U.S. carriers only), frequency limits and restrictions on fifth freedom rights with respect to combination services. It did provide for phased increase in those limits on designations and frequencies, but there are no more increases available after 2011.

The two sides have met periodically with the goal of reaching full liberalization as mentioned in the Agreement but have yet to come to an understanding. The U.S. and China have encountered some difficulties implementing the Agreement. For example, DOT continued to condition its approval of China Southern's request to co-terminalize U.S. points on its all-cargo services upon China's approval of U.S. carrier requests for additional coterminal all-cargo flights in China, where China Southern was not be allowed to co-terminalize its cargo points in the United States until China permitted additional co-terminalization of cargo points in China by U.S. airlines.

Back to Table of Contents

U.S./Japan Agreement

The United States and Japan concluded an Open Skies agreement in late 2009 that became effective and was implemented in October 2010 when the fourth runway at Haneda International Airport became operational. The agreement removes the previous restrictions on routes, code sharing, designations, frequencies, and charters. It eliminates the legal distinctions between incumbent and nonincumbent carriers so that UPS, Polar and Evergreen have the same rights as FedEx Express with respect to unlimited frequencies and fifth freedom rights. The Agreement does not include seventh freedom traffic rights for all-cargo services. The agreement allows Japanese carriers some access to Fly America along the lines granted to the EU.

In 2019, the U.S. and Japan negotiated expanded access for U.S. carriers to Tokyo Haneda International Airport (HND) because of the Japanese government's doubling of available slots at the airport. Twelve new slot pairs for combination carriers at commercially viable times were made available, bringing the total slot pairs for U.S. carriers at Haneda to sixteen. No expansion of rights for all-cargo carriers were made available, although the Japanese did affirm all-cargo carrier fifth-freedom traffic rights and change-of-gauge opportunities.

1.2 Security Constraints

In the wake of the September 11th attacks, security of air transportation has dominated the industry as a whole and the cargo sector is no exception. Although officials are keenly aware of the need to preserve the critical role air cargo plays in the world and U.S. economies, security regulation will likely be the most prominent constraint on the industry in the foreseeable future and will certainly add costs to doing business.

Immediately after the attacks, the Aviation and Transportation Security Act (ATSA) was signed into law, creating the Transportation Security Administration (TSA), the federal agency primarily responsible for air transportation security. Although initially created as part of the Department of Transportation, the Homeland Security Act of 2002 transferred TSA to the Department of Homeland Security (DHS). U.S. Customs and Border Protection (USCPB), also part of DHS, enforces regulations that impact international air cargo security. While the Federal Aviation Administration's (FAA) focus is on ensuring air cargo shipments do not present safety hazards, USCPB focuses on regulating its import and export. Although their missions have converged somewhat in recent years, TSA is primarily responsible for promulgating regulations to ensure the security of air cargo. In ATSA, Congress established two primary mandates for TSA regarding air cargo security:

- Provide for the screening of all property, cargo, carry-on and checked baggage and other articles, that will be carried aboard passenger aircraft operated by U.S. and foreign air carriers
- Establish a system to screen, inspect, or otherwise ensure the security of freight that is to be transported in all-cargo aircraft as soon as practicable.

In May 2006, TSA issued its Air Cargo Security Final Rule to implement a large part of its Strategic Plan and many of the recommendations submitted to the TSA Administrator by the Aviation Security Advisory Committee. The Final Rule established comprehensive measures to strengthen air cargo security designed to protect the cargo transported aboard passenger and all-cargo aircraft each day. The air cargo security requirements were the most significant modification to air cargo regulations since 1999 and represent a joint government-industry vision of an enhanced security baseline. Prior to this rulemaking, TSA had enacted regulations implementing its Known Shipper program and requirements

for the adoption of security programs by certain types of carriers, which detail procedures for screening cargo, verifying the identities of persons with access to planes and ensuring the security of parked aircraft. TSA periodically issues security directives (SDs), emergency amendments (EAs), or changes to security programs , to enhance these and other security measures. For example, TSA had required domestic and foreign carriers to conduct random inspections of passenger aircraft that carry cargo and all-cargo aircraft, and it required foreign all-cargo air carriers operating into and out of the U.S. to follow security programs approved by TSA. In addition, TSA has approved the use of explosive detection canine teams and technology, including explosive detection technology, to enhance the effectiveness of its cargo security program. The Air Cargo Final Rule formally codified some practices already in place and added others. Major new security measures included:

- Requiring security threat assessments for individuals with unescorted access to cargo
- Codifying cargo screening requirements first implemented under SDs, EAs, and part 1550 programs issued in November 2003

Back to Table of Contents

- Requiring airports with SIDAs to extend them to cargo operating areas
- Requiring aircraft operators to prevent unauthorized access to the operational area of the aircraft while loading and unloading cargo
- Requiring aircraft operators under a full or all-cargo program to accept cargo only from an entity with a comparable security program or directly from the shipper
- Codifying and further strengthen the Known Shipper program
- Establishing a security program specific to aircraft operators in all-cargo operations with aircraft with a maximum certificated takeoff weight more than 45,500 kg
- Strengthening foreign air carrier security requirements essentially to parallel the requirements on U.S. aircraft operators
- Enhancing security requirements for Indirect Air Carriers

Although the TSA successfully met the Implementing Recommendations of the 9/11 Commission Act of 2007 (9/11 Act) deadline for screening all cargo to be transported on passenger aircraft departing airports in the United States, the agency also established a requirement for passenger carriers to screen 100 percent of cargo on flights departing international airports for the US.

In late 2010, the TSA in coordination with CBP launched the Air Cargo Advance Screening (ACAS) pilot, an initiative to utilize manifest data submitted by passenger and all-cargo airlines in advance of departure to target high-risk shipments for additional screening. In early 2011, the TSA issued risk-based security requirements to passenger and all-cargo airlines, which required the screening of high-risk cargo shipments.

To meet the 9/11 Act requirement for screening 100 percent of cargo on passenger aircraft departing international airports destined for the United States, the TSA issued security programs to domestic and foreign airlines that included a December 3, 2012, deadline by which all cargo must be screened for explosives. Since the TSA worked closely with industry and foreign government representatives to develop the risk-based screening protocols, the requirement was not expected to disrupt commerce or the volume of cargo transported to airports in the US.

Through the ACAS Program, which in 2018 required airlines to submit information on air cargo shipments, CBP and the TSA identify high risk cargo shipments for screening prior to being loaded on aircraft.

Meanwhile, CBP implemented the Congressional mandate passed as part of the Trade Act of 2002 to require advanced transmission of electronic cargo information for both arriving and departing cargo. Air carriers importing and exporting cargo must submit detailed shipment information to CBP electronically using the Automated Manifest System (AMS). For shipments into the U.S., the information must be transmitted four hours prior to arrival for intercontinental flights and at “wheels up” for flights from Canada, Mexico, and Central and South America north of the equator. For exports from the U.S., the information must be provided via AMS two hours prior to scheduled departure from the last U.S. port.

However, the Final Amended Rule issued in 2011 amended two provisions of the Air Cargo Screening Interim Final Rule (IFR) issued on September 16, 2009. The IFR established the Certified Cargo Screening Program (CCSP), in which the TSA certified shippers, indirect air carriers and other entities as Certified Cargo Screening Facilities (CCSFs), to screen cargo prior to transport on passenger aircraft. Under the IFR, each CCSF applicant had to successfully undergo an assessment of their facility by a TSA-approved validation firm or by the TSA. In response to public comment, the final amended rule removed all validation firm and validator provisions, so that the TSA will continue to conduct assessments of the applicant’s facility to determine if certification is appropriate. The IFR also required that if an aircraft operator or foreign air carrier screens cargo off an airport, it must do so as a CCSF. The final rule eliminated this requirement, as aircraft operators were already screening cargo on-airport under a TSA-approved security program, and did not need a separate certification to screen cargo off airport. Finally, the final amended rule proposed a fee range for the processing of Security Threat Assessments.

1.3 Safety Constraints

Safety issues, which are addressed primarily by the FAA, will also continue to constrain the cargo sector.

For years, the FAA has been conducting aviation safety oversight assessments of countries around the

Back to Table of Contents

world, to determine whether U.S. aviation partners are complying with their obligations under the Chicago Convention to regulate their own carriers' safety practices. If the FAA finds a country to be doing so to its satisfaction, it assigns a Category I rating, and that country's carriers may continue to serve the U.S., and expand operations to the U.S., to the extent provided for in applicable bilateral agreements. If in the FAA's judgment the country is not in compliance with minimum international standards, it assigns a Category 2 rating. If a country has carriers with existing operations to the U.S. at the time it is assessed a category 2 rating, those carriers are permitted to continue current operation levels under heightened FAA scrutiny. If a country does not have air carriers with operations at the time of the Category 2 assessment, its carriers are prohibited from serving the U. S. However, new operations from category 2 countries are allowed if conducted using aircraft wet-leased from U.S. carriers or foreign carriers from category 1 countries authorized to serve the U.S. with their own aircraft.

As of May 2021, countries classified with a Category 2 rating included: Bangladesh, Malaysia, Pakistan, Venezuela and several Caribbean islands. The carriers of these countries may not initiate new or expand existing U.S. service, regardless of what the bilateral agreements may otherwise permit.

Some foreign countries have challenged the fairness of these FAA assessments and have questioned the authority of the U.S. to police other countries' adherence to ICAO standards. However, as a practical matter, carriers from countries rated as Category 2 face very real constraints on their ability to serve the U.S. market, regardless of how high a level of safety those carriers may be able to demonstrate with respect to their own operations.

The United States has been focused on domestic safety as well. The National Transportation Safety Board (NTSB) previously has reported the following facts regarding air cargo operations:

- There have been over 40 NTSB Cargo accident investigations since 1984
- The fatal accident risk is 2-5 times higher for cargo than for passenger operations
- The cargo fleet, while changing and shifting towards newer, more fuel-efficient aircraft, tends to be older than combination aircraft

The NTSB and Air Line Pilots Association (ALPA) International have pointed out that there are significant differences between the safety standards for cargo and passenger operations. These include less stringent operating rules regarding flight and duty time limits, reporting weather information, and alternate airports, and use of flight dispatchers. In addition, less stringent certification standards apply to cargo aircraft, which, for example, do not require safety equipment standard on passenger aircraft such as fire-suppression systems in the main cabin or lower decks, emergency exits, and exit slides. The relatively greater age of the cargo fleet means maintenance issues are more significant, including limited support from manufacturers. Moreover, many cargo aircraft undergo numerous modifications and reconfigurations, complicating maintenance. In addition, the aircraft rescue and firefighting (ARFF) requirements for airports that handle air cargo aircraft are not the same as those for air carrier passenger operations. In addition, there are no federal certifications or regulatory requirements for personnel and companies that prepare and load cargo.

To address air cargo safety issues, the FAA's Flight Standards Service developed the Cargo Strategic Action Plan and Air Cargo System Safety Implementation Plan (September 30, 2002), which identifies its long-term strategies as increasing inspector awareness on inspection guidelines by issuing an updated handbook policy and developing a formal training course.

These and other measures could add significantly to the cost of operating air cargo flights in the future.

2. Solutions to the Constraints

2.1 Petitioning the Government to Provide Special Regulatory Relief

As security and safety take on central importance, industry stakeholders must recognize their pivotal role in ensuring regulators strike a reasonable balance with economic imperatives. This requires keeping a close eye on regulatory developments and participating in the legislative and regulatory rulemaking process. Stakeholders oftentimes are most effective when taking the initiative to present specific proposals, which identify how the proposals will contribute to the attainment of national policy objectives. An example of this is passage of the Expanded Air Cargo Transfer Authority for Alaska enacted as part of Vision 100 – Century of Aviation Reauthorization Act in 2003. This initiative built on the success of the "Alaska Cargo Transfer

Back to Table of Contents

Initiative," a regulatory proceeding decided by the US DOT in 1997. As a result of these measures, the State of Alaska and its international airports have obtained essentially unlimited cargo transfer flexibility for U.S. and foreign air carriers, including use of their code share partners. These measures have helped ensure Alaska (and so the United States) retains its share of the large and fast-growing Asia-Europe cargo market. In the increasingly tense security environment, U.S. and Canadian cargo airports must continue to monitor regulatory measures that can impact their competitiveness with foreign airports, particularly Mexican airports that can function as direct competitors for handling cargo traffic transiting North America in either direction. On one hand, this means ensuring as much as possible that U.S. and Canadian regulatory requirements are paralleled to the greatest degree possible in Mexico. In addition, it means ensuring that regulatory requirements are tailored to achieve critical security objectives without unnecessarily inhibiting industry growth and efficiency.

2.2 Participating in the Bilateral Negotiation Process

ACI-NA established the U.S. International Air Service Program for those U.S. airports interested in U.S. international issues. Participating U.S. airports pay an additional dues assessment. The program promotes interests common to its participating airports, particularly with respect to the development of international air services to U.S. communities and the protection of U.S. airport proprietary rights in U.S. international agreements and aviation relationships. It also provides the essential access to the negotiating process that enables U.S. airports to promote and protect their interests with U.S. and foreign decision makers.

Carriers and airports seeking to overcome constraints created by the bilateral network will find it useful to participate actively in the formulation of U.S. policy for upcoming bilateral negotiations. Whenever negotiations are scheduled with a particular country, it is standard practice for the U.S. Government to invite all interested U.S. carriers and airports to submit written comments on the position the U.S. Delegation should take. In addition, there is normally an industry pre-negotiation meeting held in Washington which provides an opportunity to respond to issues raised by other parties and discuss more fully the points raised in an airport or airline's own written submission to the negotiators. The U.S. typically permits its airports and carriers to include a representative as an observer on the U.S. Delegation to most rounds of bilateral and multilateral negotiations. Thus, U.S. interests usually can observe directly the course of these important negotiations, and to provide input to the U.S. Government negotiators as to the progress. There are many meetings that are not open to individual parties. In some of those cases, U.S. trade associations including ACI-NA and members of the U.S. International Air Service Program can participate in the meetings.

As noted above, U.S. policy specifically contemplates cargo may be a useful steppingstone to full liberalization with countries not ready for an immediate transition to "Open Skies," and U.S. negotiators therefore may be eager to hear from airports and carriers with specific ideas for expanding international cargo services through bilateral negotiations. Airports and carriers should first assess their strengths, to effectively present their interests to decision-makers among U.S. and foreign governments and carriers.

3. Conclusion

Despite the potentially difficult circumstances it has faced during the past several years, the air cargo sector has remained relatively stable, even with recession(s) and the pandemic. Steady growth should continue in the long term, even when threatened by new U.S. and reciprocal tariffs. Air cargo carriers are positioned to play a vital role in contributing to economic growth, enabling exporters to reach foreign markets and bringing products to companies and consumers from around the world. The industry faces several constraints, including security, safety and bilateral issues. However, sophisticated cargo carriers and airports will continue to be able to find ways to work with regulators to achieve important security and safety objectives, while continuing to work toward increased liberalization of international markets and facilitate continued growth and vibrancy in the air cargo industry. The carriers, airports, forwarders and other stakeholders in the cargo industry need to take an active role in implementing regulatory relief strategies so that the full measure of air cargo's economic potential can be realized for the benefit of the national economy, shippers and consumers, and the greater industry.

Back to Table of Contents

4. Chapter 6 Appendix - Freedoms of the Air

First Freedom of the Air - the right or privilege, in respect of scheduled international air services, granted by one State to another State or States to fly across its territory without landing (also known as a **First Freedom Right**).

Second Freedom of the Air - the right or privilege, in respect of scheduled international air services, granted by one State to another State or States to land in its territory for non-traffic purposes (also known as a **Second Freedom Right**).

Third Freedom of The Air - the right or privilege, in respect of scheduled international air services, granted by one State to another State to put down, in the territory of the first State, traffic coming from the home State of the carrier (also known as a **Third Freedom Right**).

Fourth Freedom of The Air - the right or privilege, in respect of scheduled international air services, granted by one State to another State to take on, in the territory of the first State, traffic destined for the home State of the carrier (also known as a **Fourth Freedom Right**).

Fifth Freedom of The Air - the right or privilege, in respect of scheduled international air services, granted by one State to another State to put down and to take on, in the territory of the first State, traffic coming from or destined to a third State (also known as a **Fifth Freedom Right**).

ICAO characterizes all "freedoms" beyond the Fifth as "so-called" because only the first five "freedoms" have been officially recognized as such by international treaty.

Sixth Freedom of The Air - the right or privilege, in respect of scheduled international air services, of transporting, via the home State of the carrier, traffic moving between two other States (also known as a **Sixth Freedom Right**). The so-called Sixth Freedom of the Air, unlike the first five freedoms, is not incorporated as such into any widely recognized air service agreements such as the "Five Freedoms Agreement".

Seventh Freedom of The Air - the right or privilege, in respect of scheduled international air services, granted by one State to another State, of transporting traffic between the territory of the granting State and any third State with no requirement to include on such operation any point in the territory of the recipient State (i.e. the service need not connect to or be an extension of any service to/from the home State of the carrier).

Eighth Freedom of The Air - the right or privilege, in respect of scheduled international air services, of transporting cabotage traffic between two points in the territory of the granting State on a service which originates or terminates in the home country of the foreign carrier or (in connection with the so-called Seventh Freedom of the Air) outside the territory of the granting State (also known as a **Eighth Freedom Right** or "**consecutive cabotage**").

Ninth Freedom of The Air - the right or privilege of transporting cabotage traffic of the granting State on a service performed entirely within the territory of the granting State (also known as a **Ninth Freedom Right** or "**stand alone**" **cabotage**).

Source: Manual on the Regulation of International Air Transport (Doc 9626, Part 4)

Back to Table of Contents

Chapter 7

The Airport – Tenant Relationship

Back to Table of Contents

1. Introduction

Airport operators are increasingly recognizing the substantial economic value that air cargo contributes to their service regions. As interest in cargo development grows, so does the complexity of managing relationships with cargo tenants. These relationships are shaped by both operational demands and the intricate contractual frameworks that govern how the parties interact. Understanding these dynamics is essential for airport managers aiming to support cargo growth while aligning with broader public and operational responsibilities.

While airport operators are guided by significant public responsibilities and regulatory obligations, their tenants are primarily motivated by private-sector profit interests. These differing perspectives should not overshadow the meaningful opportunities for collaboration.

2. Air Cargo Stakeholders

2.1 Airports

In its role as public landowner, public guardian and local advocate for regional services, the airport has a vested interest in ensuring that assets are put to their optimal use while balancing environmental and noise considerations. Throughout this juggling act, airport operators must respect both the long-term perspective of the Airport Master Plan and the users' more immediate needs and expectations of equitable treatment. Airport operators must determine whether they desire to lease directly to the airlines and other cargo users, or to introduce a developer into the airport's development process. Airport operators must consider all options when formulating the planning, construction, marketing and operations of cargo and its related businesses.

2.2 Airlines

Today, airlines come in a broad range of operational configurations. Not even accounting for various surface modes which may also be utilized for one or more transport legs, air transport of cargo typically occurs in one (or more) of four ways: the belly of passenger aircraft, in combi-aircraft, via integrated carriers, or in all-cargo carriers. Each category has distinctive networks, operational styles and landside requirements. In developing its physical infrastructure, airport management must evaluate the needs of each type of cargo operator. The ability to attract and maintain cargo operations is directly related to an airport's ability to address individual airline requirements with planning flexibility and financial responsiveness. Many foreign passenger carriers operate freighters and most U.S. and Canadian passenger carriers maintain cargo divisions. All routinely reexamine landside capital investment strategies. In cases where passenger yield management goals have been achieved by changing fleet mix and adjusting route structure, the result for cargo has been reduced belly capacity and an increasing reliance on all-cargo aircraft. These conditions were greatly exacerbated by the events of September 11th, 2001, and its aftermath in which airlines initially shed capacity to match reduced demand. As passenger demand returned, airlines restored passenger capacity using regional jets with diminished cargo capacity. One should also consider the profound impact of COVID-19, which prompted airlines to adapt quickly, converting passenger aircraft to transport critical supplies, including the much-needed Personal Protective Equipment (PPE), vaccines, and other essential necessities. As cargo operations expanded and more goods moved via surface and freighter transport, airports were forced to adjust infrastructure and logistics to meet rapidly changing demands.

2.3 Freight Forwarders & Customs Brokers

Despite extraordinary market share gains by the integrated carriers, freight forwarders continue to be essential for effective goods movement by air, especially for international transport. While the relationship between forwarders and airlines can be challenging at times, there is still interdependence acknowledged by both parties. While freight forwarders historically have been perceived as little more than a travel agent for freight, many of today's more sophisticated forwarding companies operate vast trucking fleets and a few command scheduled charter flights with cargo airline partners. Although many forwarders may choose to locate on less expensive property off-airport, recent security concerns have elevated the perceived value of an on-airport operation. While some forwarders are wholly niche-oriented, even the largest companies have departments dedicated to specific geographic areas or industries, including dedicated computer, pharmaceutical, chemical and automotive divisions.

Back to Table of Contents

While forwarders serve exporters, customs brokers cater to the needs of importers. Many freight forwarders and integrators may include customs brokerage functions; it is also common for these industries to have agency agreements with independent brokers. For both forwarders and brokers, success is increasingly dependent on their ability to integrate their own systems with those of shippers, carriers, forwarders, and federal inspection agencies worldwide. Recognizing that rapid clearance of goods is among their most critical functions, brokers play a crucial role in the cargo delivery chain. While electronic tracking and clearance systems have reduced the need for brokers to physically maintain offices on the airport premises, frequent complications suggest that proximity to the airport and federal customs is desirable.

2.4 Shippers

Having exhausted much of the low-hanging fruit in terms of time and money-saving manufacturing innovations, producers and suppliers are increasingly concentrating on logistics as a critical component in global competition. Providing the maximum in time expediency and delivery reliability, air transport's appeal has been magnified in the era of just-in-time manufacturing, zero inventory distribution and contracted product life cycles.

Where physically and financially feasible, these major manufacturers and distributors are locating logistics centers on or near those airports that can provide the necessary lift. Increasingly, this strategy has led to the airport's enhanced role in local economic development efforts to lure companies to cities that are perceived to have an air cargo competitive advantage. This recognition has also galvanized industry discussion of all-cargo airports, although in North America few such airports are likely to be successful if ample capacity exists at existing commercial airports.

2.5 Ground Service Providers

Frequently, the ground service provider (GSP) is the link between the aircraft and the warehouse. The GSP loads and off-loads cargo, moves it to and from the warehouse, in the warehouse and truck loading. Historically, these operators have functioned in a fiercely competitive environment where cost-minimization was the dominant criteria in bidding for business. However, the industry has evolved from the obsession with low cost, to emphasizing value; balancing cost with quality. As a result, many air carriers are outsourcing part of their cargo operations to handling companies who gain economies of scale and cost efficiencies by utilizing staff and equipment for multiple carriers. While this initially results in consolidation of space requirements and more efficient use of facilities, thereby reducing overall space requirements, the increasing provision of value-added services by GSP's eventually creates demand for additional space. As handling companies assume these larger roles, their need for GSP facilities and operating facilities on the airport will continue to grow.

2.6 Trucking

Ground transportation plays a critical, yet occasionally overlooked role in air cargo delivery. Not only do trucking companies serve airlines and forwarders but the major integrators rank among America's largest trucking companies in fleet size. This activity utilizes considerably more space than many airport operators realize, placing a substantial, yet often neglected impact on facilities and road maintenance, planning and development. At some airports, estimates of the cargo volume that moves entirely truck-to-truck can run as high as 30% of the total movement. Whether freight is moved plane-to-truck or truck-to-truck, air cargo is inherently intermodal. Airport planning and design must include considerations of air cargo trucking in roadway geometry, building frontages and building design. Facilities for truck maintenance or truck to truck operations may also merit consideration. While most trucking companies do not have to be on-airport, the movement of logistics and manufacturing centers closer to airports may spur a change.

3. Who Should Build? The Selection Process

Airports have several strategic options when considering the planning, development, construction and marketing of air cargo facilities. The choice depends on available funding, internal expertise, risk tolerance and long-term revenue goals:

- Airport-owned and operated facilities; when sufficient capital and in-house development expertise are available, many airports choose to develop and manage cargo facilities themselves. This approach involves greater risk but offers several advantages:

Back to Table of Contents

- Increase revenue potential through direct leasing
- Greater control over airside operations and facility standards
- Eligibility for state and federal grants, which can reduce overall project costs
- Airports may pass along cost savings to tenants in the form of reduced rents, improving competitiveness and tenant retention
- Development by End Users or Third-Party Developers:
- End Users (e.g., airlines or ground service providers) for their own operational needs
- Third-Party Developers, who take on full responsibility for financing, construction, marketing, leasing and facility management.

When end users develop their own space, negotiations typically move quickly and the facility can be tailored to specific operational requirements. Using third-party developers reduces financial and operational risk for the airport.

A comparative matrix of pros and cons for using third party developers is provided below to assist in evaluating these options.

Pros & Cons of Private Facility Development

- PROS
- Financing:
- Developers' financing has no recourse to airport nor effect on its credit rating. Risk related to occupancy, bankruptcy of tenants and associated debt-service considerations is borne by the developer
- Typical air cargo facilities financing, including those using tax-exempt, special facilities airport bonds, do not affect airports' borrowing limits and caps
- Net result is to allow airport operators to invest their own funds in other priorities, including improvements with greater return-on-investment or operational priorities
- Accelerated ground-lease income on property not currently utilized
- Improvements revert to airport at no expense after initial land-lease term
- Private development costs may be 15%-20% less than public.
- Marketing:
- Developers provide marketing resources which may even relieve the airport of need for cargo-specific staff
- Developers have vested interest in leveraging their existing tenant relationships at other airports in their networks in pursuit of greater occupancy.
- Intangibles:
- Most developers bring cargo facilities expertise lacking at many airports
- Often, developers supply improvements, such as utilities, aircraft parking ramps and other infrastructure for which airport may not have available funds
- CONS
- Financial Considerations:
- Public airports often have unique access to less expensive funds; privately funded buildings may carry relatively higher rental rates depending on the financing model
- Should developers go bankrupt, airport operators may be reconciled to partnering with financial institutions that have neither the industry sector skills nor motivation to aggressively pursue cargo

Back to Table of Contents

development

- Many cargo carriers still perceive that private developers inject an extra layer of costs into cargo facilities that otherwise would not be necessary
- Control:
- Airport operators must ensure through leasehold provisions that privately-operated buildings and infrastructure are maintained (appearance, safety and security) consistent with airport standards and federal regulations.
- Ability of airport operators to undertake speculative facilities development in pursuit of local economic development objectives may be incompatible with motivations of private developers. Similarly, application of public incentives to attract new service may be complicated by participation of private developers.

There are more complex situations that arise in which facilities will be required for either multiple tenants or where the demand for the facilities is unclear; a third-party developer/operator may be willing to construct facilities. In this case, airport management should initiate a clear, coordinated and transparent selection process to determine who will develop the site. First, the governing authority must devise an orderly review process, identify a qualified selection committee and clearly define the evaluation criteria that will provide the basis for selection of the developer. Airport management conducts a Request for Proposal (RFP) as an open competition to select the best lessee for a particular site. Numerous positive and negative examples exist to inform prospective airport landlords of techniques for devising a productive RFP.

It is important to note that RFP processes for development represent tremendous time and cost to prospective developers. Airports should be committed to the process and to the resultant deal and partnership prior to initiating the process.

Where airports are not bound by public statute to conduct RFP's, many have opted for a less formal selection process involving the marketing of selected land tracts to qualified lessees and end users on a conditional first-come, first-served basis. This approach is ideal for airports with abundant land (i.e., greenfield sites) and easily established values, particularly if cargo development is described and anticipated in the Airport Master Plan and subsequent development can be directed to comply with the intentions of that planning document.

4. Types of Agreement & Contracts

4.1 Developers

While carrier and third-party development have been utilized at some airports extensively, these forms of development have become even more attractive in recent years when airport operators' own resources have been strained and carriers have opted to invest in aircraft rather than real estate. Several key phenomena have been responsible for the change.

- Fluctuating fuel prices and economics have resulted in operating in bust and boom balance sheets for many airlines, forcing carriers to reconsider route structure, frequencies and fleet mix. To maximize revenues, carriers have sought to optimize passenger load factors by reducing capacity; this has become a double-edged sword. On the one hand, cargo's traditional function was to consume the belly capacity remaining after baggage was loaded. However, new fleet mixes for many carriers included significantly less belly capacity. E-commerce, the changing fleet mix, coupled with security requirements, has made shipment of cargo in bellies on certain routes more difficult, thereby less desirable; increasing the industry's reliance on all-cargo freighters. Many airports are not physically equipped to handle these aircraft. Moreover, airports confront this challenge with their own available capital for expansion already strained by the preceding losses in operating revenues, combined with increased security-related operating costs and expectations of future cargo-related security outlays. On the other hand, the growth of new international passenger service using wide-body aircraft has caused many carriers to abandon freighter acquisition strategies and pursue greater utilization of belly capacity. This bifurcation of industry strategies makes it important to consider who the carriers are and their specific needs before major infrastructure investment.
- The amount of Airport Improvement Program (AIP) grant money dedicated to cargo (cargo entitlements)

Back to Table of Contents

is very small and considered by many, inadequate. As air cargo tonnage has increased, federal funding as a percentage of total cargo capital needs has declined considerably. The combination of insufficient federal funding and the need for substantial infrastructure investment has led airports and airlines (who prefer to invest their capital in aircraft) to increasingly consider private developers.

- There is another option to develop logistics parks to stimulate cargo activity while at the same time generate incremental revenue for airports and new jobs for the region. Since much of this development may be considered ineligible for federal grant money, a private partnership is a logical consideration.

However, it would be presumptuous to assume that private development presents a universal solution. Absent several key ingredients, the inherent difficulties can be substantial.

- The developer must recognize that the airport has obligations and objectives that are more than financial and encompass other areas such as safety, security and operational requirements.
- The airport must consider whether they will assume a share of development risk, depending on their analysis of the overall market potential and the policy the airport has established toward cargo development
- Inherent in the Airport-Developer relationship is a difference in perspectives on revenue generation. While long-term leases are typical and all facilities/improvements ultimately revert to the airport, a developer's short-term needs and finite window for capitalization and profitability may conflict with the airport's longer-term perspective.

Basically, what must emerge is a working partnership based on mutual flexibility and risk. While developers bring investment, expertise and often new tenants, airport management controls a unique, restricted resource: airport land. Both ideally and realistically, the partnership should benefit the airport, developer, tenants and local economy. While airport operators bear public accountability, developers must conform to the expectations of their potential lenders and tenants. Failure to do so may compromise the ability to finance and/or lease the development. As private development at airports becomes more common, the process is becoming more streamlined and certain guidelines and practical realities are gaining in acceptance.

A critical element in the mix is the cost allocation for related infrastructure that may not be easily recoverable by the developer. The key to successful development may ultimately require that airports consider investing their limited federal funds to stimulate private sector development activity by sharing costs.

5. Bankruptcy Provisions & Other Termination Scenarios

While introducing many operational improvements, airline deregulation also brought a high number of airline bankruptcies. That era produced much of the prevailing methodology for protecting airports from the injuries of such proceedings. For many airport contract managers, the first round of airline bankruptcies amounted to uncharted territory but provided invaluable insight into more recent (and ongoing) airline bankruptcies. Navigating federal bankruptcy codes, airport operators can find themselves in protracted efforts to seize collateral assets or merely to regain occupancy of facilities leased to airlines in bankruptcy. In the worst cases, airport operators have endured lengthy periods in which precious resources were untouchable and providing no revenue while courts and creditors deliberated. There have been other situations that do not reduce the airport's revenue but do damage the airport's image and could potentially increase its future cost of borrowing.

In recent years, several airlines have financed the construction of special purpose airport facilities with tax-exempt special facility bonds. Unlike general airport revenue bonds, which are typically used to finance most airport infrastructure and are repaid from general airport revenues, special facility bonds are unique in that they are repaid solely by the user or from the revenues of the special purpose facility. In addition, up to this point, it has not been uncommon for special facility bond deals for major airlines to be structured as unsecured loans, which essentially means that if the airline defaults on the special facility debt, the bondholders do not get paid and have no collateral in the financed facility. It is critical to ensure that any bond deals are structured to provide adequate collateral for both the bondholders and the airport. This can be accomplished by giving the bondholders a security interest in the leasehold and/or revenues of the special facility being financed. (For greater detail, see Chapter 5)

On a parallel track, airlines continue to explore and go through mergers and acquisitions. In the case of healthy airlines acquiring the assets of bankrupt airlines, airports have sought to attach existing liabilities to

Back to Table of Contents

the acquisition partner (e.g., as Kansas City International Airport (MCI) and St. Louis Lambert International Airport (STL) attempted with American Airlines' assumption of former TWA assets). Conversely, airports have sought to sever existing contractual obligations when tenants have been acquired by operators who were perceived less favorably. Airport managers must be vigilant and anticipatory in preparing contracts that provide sufficient flexibility to bind or unbind tenants in critical future junctures.

Depending on prevailing ownership standards, airport management's cargo leases may include contracts with cargo carriers, ground handlers and/or developers. While the contract language may vary, some concerns will be consistent regardless of whether the airport operator is leasing directly to air cargo carriers and ground handlers or to a developer.

For example, airport management must ensure that insurance standards by developers and/or carriers will cover environmental cleanup should a bankrupt operator leave contamination. Similarly, airport operators must be properly indemnified for injury and any other liability concerns that could potentially be left by a bankrupt operator. Airport management will most likely require proof of sufficient coverage from both the developer (if there is one), as well as the carriers and other cargo tenants.

5.1 Contractual Covenants

Assignment and Subletting by Tenant

When leasing directly to cargo carriers or other operators, airport management must maintain clear authority over the terms and conditions under which leasehold interests or premises may be assigned or sublet.

Airport leases should include explicit provisions requiring tenants to notify the airport in writing in any part of the leased space that will be assigned or sublet to another party. In the event of an assignment, the airport operator will seek to ensure:

- that the sub-tenancy is for an appropriate use
- that all existing obligations of the tenant are maintained

Again, this condition is particularly critical when the lessee of record files for bankruptcy. On the other hand, airport management will similarly want to ensure that the authority's acceptance of an assignment of lease does not reduce the obligations (rentals, fees, and other charges) of the lessee of record, that the secondary assignee should file bankruptcy. Under either scenario, it is incumbent on the airport operator to ensure that the full obligation of the tenant is maintained. In extreme cases, airport management may require the procurement of a surety bond to establish assurance of the reliability for rental payments, potential damages, and any other costs.

Relinquishment of Space

Frequently, an operator (carrier or ground handler) in financial distress will seek to relinquish all or part of its exclusive use or joint-use space. If the user has not exhausted the term of its contractual obligation for the space, the standard contracting procedure is to require the tenant to notify management in writing of its desire to relinquish. Airport management may use its best effort to offer relief by marketing or reassigning the space. However, the tenant seeking to relinquish space will frequently retain its obligation until the space has been successfully reassigned, regardless of actual usage.

Default and Termination

Contrasting with situations in which tenants may move to relinquish space prior to or during bankruptcy, airport operators may have to take action to regain control of space from unwilling carriers or ground handlers. In these instances, it is critical that lease contracts contain cure provisions and clear, enforceable remedies. When existing cargo facility space is approaching or already at full occupancy, no airport operator or developer wants to have space occupied by an idle tenant while potential carriers or ground handlers are forced to wait for availability. It is essential that airport management have a clear contractual basis to initiate default and termination proceedings. Typically, these covenants will specify a standard or schedule for rental and/or other payments. However, airports may also include activity-based standards to mitigate the potential for limited cargo space to be reserved by idle cargo operators. Although the carrier may desire to continue paying rent for a period, the airport could be better served by allowing another operator to occupy the space in question.

Back to Table of Contents

Bonds

The single largest source of airport funding is bonds. This remains the case. Tax-exempt bonds may be issued by airport authorities, as well as state and local governments in the U.S. Since 1982, 95% of all airport debt has been in the form of General Airport Revenue Bonds (GARBs), which are secured by an airport's future revenues. However, airports may also issue Special Facility Bonds (SFB's) that retain the tax-exempt status but are generally secured solely by the revenue from the indebted facility (terminal, cargo warehouse, and apron), rather than the airport's general revenue. Large hub airports have issued many special facility bonds.

Given that bonds have a term of 15-30 years, airport operators may potentially be faced with a bankrupt tenant that was perfectly healthy when the bonds were issued. If GARB financing were used to issue the bonds, the airport operator would have to divert other airport revenues to cover scheduled bond payments while attempting to secure another productive tenant. The airport operator might attempt to refinance, although having a replacement tenant in line would likely be essential to the success of any new bond sale. If SFB financing was used, the creditor (bondholder) or developer would usually end up with the facility, which would then remain in unproductive status until a viable tenant could be found. In all cases, the sponsors must be attentive to their bond covenants to ensure that a possible change in operating conditions would not jeopardize the bonds' tax-exempt status.

6. Pricing of Airport Facilities and Services

The most important element underlying pricing strategy is flexibility. Fees that airports charge for services must be adequate to recover costs for both long and short-term agreements. Historic long-term lease agreements (typically 30 to 50 years) for new development, have not provided airports with the flexibility required to address the challenges of deregulation, dwindling federal support and changing times and practices. The current trend is to view the airport-as-a-market with a movement toward short-term use agreements for existing space. The shorter terms provide airport operators with greater flexibility to adjust pricing, investment policies and space allocation. While often for five years or less, many contracts may even take the form of yearly or month-to-month operating agreements. As older contracts expire, many airports are routinely shortening the term of renewals and/or inserting more adjustments of rates and charges into existing agreements.

In contrast, long-term leases are more critical at airports allowing carriers or third-party developers to build cargo facilities. In these situations, carriers or developers typically pay the airports only a land lease for the ground with the property and improvements reverting to the airport authority at the end of the lease. To amortize their investment, developers require a minimum of 25-30 year leases, occasionally with 5-10 year renewal options.

In the cargo community, the debate continues over which pricing method best addresses current realities. The cost allocation method, joint-product model and derived demand models all have merit. However, airport rate structures typically are more influenced by the comparative rates and charges of other airports or regional real estate costs, than by an airport's cost recovery system.

In determining rental rates, airports must be mindful of their competitiveness. In addition to the obvious gauge of comparative rental rates against other locations on and off-airport, competitiveness is determined by facility condition, apron access and proximity to tenants' clientele. The airport should also compare its total marginal cost of having or operating facilities (infrastructure carrying cost, operating costs such as security and fire protection, utilities, maintenance, personnel, administrative and accounting expenses) with its rental and other fee revenues, such as landing and parking fees.

The following is a partial summary list of terms commonly negotiated in air cargo facility development contracts:

- Rental rates: usually expressed in dollars/square foot/year, on any tract of land. If the airport wishes to share in risks and greater rewards, this fixed rate may be combined or replaced with a rate based on a percentage of gross or net revenues.
- Appraisal process: as the ground rent may be tied to the value of the property, this issue is important to all parties concerned. One inherent difficulty is the identification of comparable properties.
- Rental rate increases: through the term of the ground lease, airports will often require scheduled rate increases, often based on consumer price index (CPI) or some other method agreeable to both parties.

Back to Table of Contents

- Lease terms: ranging from 25-50 years. It has become common to offer a series of five or ten-year extension options to the site lessee beyond the original lease term.
- Rent start date: usually at substantial completion or occupancy of the property by the lessee.
- Site Definition: typically determined by a survey, but it is important to make sure that ground is being offered and leased, including requirements for impervious cover, drainage, etc.

7. Airport Fee Structure

Airports and their tenants must balance their individual objectives with the ultimate pragmatic goal of cultivating a mutually beneficial win-win relationship. While operating within a competitive environment, U.S. airports are subject to a myriad of federal regulations that govern how airport services may be priced. For airport operators that accept AIP monies, CFR 14, Part 152 (known as airport grant assurances) require airports to set rates and charges at levels sufficient to make the airport as self-sustaining as possible. Other federal regulations require airport operators to collect sufficient revenues to cover operating and other costs (net of federal grants and Passenger Facility Charges) on the airfield and terminal but require fair market value pricing on all non-aviation assets. As airports are assuming more of a bottom-line orientation, an emerging common ground should prevail. Airline negotiations frequently raise debates over the reasonable expenses comprising all the fees and expenses which airport management charges to airlines and other users. Many of the airlines' operating costs fall beyond the control of airport management. These typically include the availability and cost of fuel, labor, cost of living, quality of life, and federal, state and local taxes.

7.1 Fee Methodology

At most commercial service airports in the U.S., the financial and operational relationships between the airport operator and the airlines are defined in legally binding agreements that specify how all risks and responsibilities will be borne. These contracts (commonly termed airport use and lease agreements) establish the terms and conditions governing the airlines use of the airport. They also specify the methodology for calculating the rates and charges that airlines must pay for use of airport facilities and services. Along with the airlines' responsibilities, these contracts identify the airlines' rights and privileges, frequently including the right to approve or disapprove proposed airport capital development projects (i.e., Majority In Interest clause). While financial management practices differ greatly among commercial service airports, the airport-airline relationship typically takes one of two very different forms, with important implications for airport pricing and investment:

- In the residual-cost approach, the airlines collectively assume significant financial risk by agreeing to pay any costs of running the airport that are not allocated to other users or left uncovered by non-aeronautical sources of revenue.
- In the compensatory approach, the airport sponsor assumes the major financial risk of running the airport by charging the airlines fees and rental rates established at a level anticipated to recover the actual costs of the facilities and services or for distributions to its stockholders in the case of privately owned commercial airports.

For airports using the compensatory approach, the pricing of airport facilities and services may be set (subject to all federal laws and regulations) more than break-even levels.

7.2 Aircraft Landing Fees

Traditionally, the single most important source of revenue for most airports has been the landing fee charged to operators of aircraft. Since the initiation of air service, landing fees have been based on the weight of the aircraft, usually either the maximum gross landing weight (MGLW) or the maximum gross takeoff weight (MGTW).

Several variations exist to these two options, including the following types of landing fees instituted by airports around the world:

- A fixed rate per 1,000 pounds (or some other unit of measurement) irrespective of the total weight. The total charge is calculated my multiplying the unit charge by the number of 1,000-pound increments.
- A rate per 1,000 pounds, with weight breakpoints, so that the rate increases in plateaus as the total weight

Back to Table of Contents

increases. An aircraft is charged by multiplying its weight times the appropriate rate per 1,000 pounds, for that weight category.

- A rate per 1,000 pounds, with weight breakpoints, so that the rate increases in steps as total weight increases. This means that the first 30,000 pounds of an aircraft's weight may be charged at the rate for that weight range, but the next 30,000 pounds (weights 30,001 to 60,000 pounds) will be charged at another rate and so on. At a few airports, the rate per ton decreases incrementally as the aircraft weight rises.
- A rate per 1,000 pounds, whether fixed or with weight break points, dependent upon the nature of the flight. Traditionally, there are two categories of charges: one for domestic and one for international flights. In some countries, the stage length has been used to differentiate the unit charge. Regardless of the basis of differentiation, the aim has been to ensure that aircraft on longer flights pay a higher unit rate.
- A few airports replaced the weight-based landing fee with a single fixed charge, regardless of aircraft size dated in the early 1990's; such method is used less frequently.

In the U.S., the most common landing fee is a fixed rate per 1,000 pounds of an aircraft's maximum gross landing weight. Variations of this basic landing fee are used infrequently in the U.S. As these formulae penalize long-haul operations, landing fees that are based on stage length or the maximum gross takeoff weight (heavier than an aircraft's maximum gross landing weight) are utilized mostly by airports that lack the need to compete for heavy transport aircraft. In most instances, penalizing long-haul operations is not in an airport's best interests. Similarly, a single fixed landing fee that does not discriminate between aircraft sizes, but which may vary at different hours of the day, is used to discourage traffic during peak periods. Again, relatively few airports have such leverage or lack a compelling need.

To encourage activity, some airports grant fee exemptions for a carrier's introductory period (based either on time or volume) of operations and most airports maintain lower rates for signatory or scheduled carriers compared with non-signatory carriers and itinerant charter aircraft. While not an industry standard, some airports have introduced a cargo-only signatory agreement as an enticement to nurture cargo operations while recognizing that cargo operators are unlikely to reap the full benefit of the passenger terminal improvements that often drive airport investments and subsequent costs.

Landing fees can vary dramatically among airports. Based on an airport's financial status and capital improvement programs, substantial adjustments to the landing fees may be required to attract new business. These kinds of modifications may be implementable - provided such adjustments are non-discriminatory.

7.3 Aircraft Parking Fees

Aircraft parking fees are a common means for airports to charge airlines for aircraft stays beyond the free-parking period, generally two to six hours, covered by the landing fee. Airlines may be required to pay a charge for preferential non-exclusive parking on the airport's apron or ramp. This charge does not apply to aircraft parked on apron space leased to the airline.

The parking fee, or ramp fee, is typically a charge per hour or unit of hours. Frequently, twenty-four hours is used as the billable time unit once the free period has been exhausted. However, this methodology provides no incentive for airlines to vacate parking stands once they have entered a twenty-four-hour period. To improve utilization of parking stands, airport operators should institutionalize a very short preferential, non-exclusive free-parking period followed by a parking charge for each hour that an aircraft stays on the stand. This methodology would reduce the number and cost of required stands while introducing another source of revenue. With a preferential non-exclusive agreement, an air carrier's preference at a particular site does not supersede the requirement to move idle aircraft if another carrier requires that parking position.

The parking charge is typically calculated based on the aircraft's weight or, less often, on its area (wingspan X length). If based on weight, the parking charge will typically be a fixed amount per 1,000 pounds. The parking fee may vary between different areas of the airport, and fees for preferential use of prime parking areas may be applied. Ramp fees may also be allocated according to each airline's prorated use of common ramp area.

7.4 Other Aeronautical Charges

Additional charges are levied selectively by individual airports but are not universal. In the U.S., the most

Back to Table of Contents

common example is the fuel flowage fee, typically a flat charge per gallon of fuel.

Airports have also begun to impose separate charges for specific facilities and services that may be used in the process of enplaning or deplaning cargo. These charges may include fees for deck loaders and security charges. Incremental security charges are being explored as a means of defraying the costs of heightened security measures being considered for cargo carriers. Like how passenger airlines collectively defray the cost of passenger security screening, cargo charges could be implemented to pass increased surveillance and monitoring costs to the airlines.

Many airports also charge a fee or commission to ground handlers who perform services for cargo carriers operating at the airport. The fee is generally calculated against the gross value that the ground handler has billed to the airlines. At airports where multiple airlines are served by a ground handling company, the commission can be substantial.

Some or all these fees may be waived as enticements to new operators for an established, fixed period. Similarly, the applicability of these fees may vary between signatory and non-signatory airlines, as well as for airlines which self-handle their operations.

7.5 Related Fees

Individual airports have introduced a diverse array of surcharges and rebates, augmenting the basic landing fee. These are usually related to the distance of the flight, aircraft noise levels, and night landings

8. Safety, Oversight and Control

Safety, oversight, and control often invite conflict comparable to the compensation motives of airports and developers. While tenants prefer that the airport operators exercise as little oversight as possible, airport management is held responsible for activities on its property. Among entities exacting that accountability is the FAA, the airport's other tenants and the surrounding community. In contrast with some of the site and pricing issues previously explored, both parties must be aware that many control concerns have no flexibility; non-negotiable. This section outlines some of the safety, oversight and control issues that frequently appear in facility negotiations. Several related issues were explored in the bankruptcy section earlier in this chapter:

- Use of facilities: airport management will opt to restrict air cargo-related activities to air cargo facilities or an air cargo complex
- Ingress and egress: control of access, both on the landside and airside, is critical to the security of the airport, the value and utility of the property and its operational effectiveness
- Assignments and subletting: for security reasons, as well as bankruptcy liabilities, airport management should control to whom the tenant subleases or assigns its lease
- Financing restrictions will include subordination of the rent payments, encumbrances and lender re-entry rights
- Control of transport of hazardous materials on site to comply with local, state and federal requirements
- Environmental controls, including the establishment of an environmental baseline for the site, handling of contaminants and liabilities for pollution created after the baseline
- Facility entry and inspection rights: airport personnel should have the right to enter the property at reasonable times if inspections are required
- Insurance requirements: a list of categories of insurance, mandatory amounts and description of shared liability
- Indemnification of officials: most airports want to be held harmless, to the extent possible, for anything other than negligence or mismanagement
- Architectural, construction, landscaping and signage restrictions, including approval procedures, bidding restrictions, as well as, future tenant modifications, etc.
- A statement of the obligations of the lessee for care and maintenance of the property

Back to Table of Contents

- Condemnation procedures: should the lessor need to take over the property through condemnation
- Availability and responsibility for utilities
- Regulations related to construction and operations of the facility within the non-discrimination guidelines of the airport and community
- General Airport Operating Area (AOA) and airport security requirements
- Conformance to FAA Guidelines
- Institution of performance measures
- Events of default and cure, including notice and cure periods
- Recourse for non-performance of lease terms

9. Location

Among the most negotiable is the determination of the prospective facility/development site. It is essential to comprehend the dynamics of site selection, including the pros and cons of the various site alternatives. The single most important planning criterion for any airport is the effective utilization of its land resources in accordance with the airport master plan. The temptation for quick development and new revenue must be carefully weighed against the optimal long-term land use strategy. Both present and future development needs must be considered.

Airport users have at least two basic categories of property that may be used for air cargo facility development:

- ON-AIRPORT sites may have or provide (via service road) direct airside access or may be non-airside
- OFF-AIRPORT sites are not typically owned or controlled by airport management but must be considered as real competition that could impose pricing pressure on lease rates for potential tenants that do not require aircraft parking. Historically off airport properties lease at fifty percent or less per square foot of an on-airport facility with ramp.

Among carriers, forwarders and other ancillary services related to air cargo and logistics, debate continues on the relative merits of operating on or off-airport. Depending on the operational characteristics and requirements of the user, both locations have their merits.

On-airport properties consist of three types: airside, non-airside with airside access and non-airside. Airside properties provide direct access to aircraft parking ramps while non-airside with airside access connect to the AOA via restricted service road. While still on airport grounds, non-airside properties provide no airside access. Airside facilities are ideal for integrated express carriers that fly aircraft into the airport and require fast, direct handling of cargo next to their aircraft parking positions. While this space is typically more expensive than non-airside property, carriers save operating costs and time by transferring their cargo in the most direct manner, from aircraft to warehouse, rather than using additional ground transportation. Integrators are not the only operators utilizing this operating method. By sorting at their airside facilities, operators can eliminate one handling step, dramatically improving their efficiency, control and profitability.

For operators whose limited needs can be met by tug access to the ramps, non- airside with airside access, facilities are an alternative. These facilities are usually located very close to airside facilities and the passenger terminal. Forwarders, ground handlers and other logistics companies who only need limited access to aircraft, typically do not have their own aircraft or lack a compelling need to be on the ramp and can be located more remotely. Typically, their facilities are less expensive than airside property. There is no set design for these facilities. Some may be somewhat wider and larger than airside facilities, taking on more of a warehouse appearance. Lacking ramp access for aircraft, these facilities may take on cross-dock characteristics with trucks entering and docking on both sides of the building. These facilities will often contain more offices and other specialized features, due to their greater affordability that encourages the user to consolidate more activities on site. Airport operators must often consider the advisability or legality of operating tugs on or across public roads when considering this alternative.

Salient features of on-airport facilities include:

- Since the land is usually ground-leased from the airport, tenants generally do not own their premises.

Back to Table of Contents

Depending on the strategy of the tenant, this may influence a tenant's choice of location; particularly at airports where airside facilities are limited and rental rates carry a premium.

- The tenant must balance location considerations against operational efficiencies, particularly if aircraft will be involved.
- Depending on the age of the landside features of any on-airport facility. Many older facilities have congested truck aprons and limited private vehicle parking conditions.
- An on-airport facility comes with very specific operating, security and safety guidelines that are typically more constraining than those at an off-airport facility.

Because each airport has its own environment and operating conditions, there is no single standard by which to evaluate the different types of facilities. However, one can identify certain market features that consistently influence rental rates as well as geographic and local economic conditions. In addition to existing supply/demand evaluations, rates are also affected by the financial and land capacities, both on-airport and off-airport, which could dictate future supply.

While logic dictates that more and consequently cheaper land space exists off-airport than on-airport, older airports and gateways are particularly susceptible; air cargo land space tends to be smaller and more built-out. Hence, on-airport facilities command a higher rental. Standards estimate that airside facilities rent for approximately 25 percent more than non-airside and on-airport facilities for twice as much as off-airport facilities. This standard fluctuates widely depending on the availability of such facilities.

To support the effective movement of goods, an airport should have a healthy mix of well-connected and accessible on and off-airport facilities. These facilities must be priced competitively to attract new users and keep current users. Airports should encourage competitive air cargo environments and lessees. By and large, developers will concede that competition breeds innovative and effective development of facilities. A good mix of both on and off-airport facilities is an essential economic catalyst for communities seeking global connectivity.

10. Landside Requirements

While configurations vary greatly, most airside facilities offer aircraft parking immediately in front of the facilities, accessed by at-grade warehouse doors. Cargo handling areas, between the buildings and the aircraft, typically run about 50 ft wide.

Modern cargo buildings vary greatly - as deep as 250 feet for freight sorting and as shallow as 60 feet for expedited throughput. The range largely depends on the extent to which operators will sort cargo on the premises. Landside facilities typically offer truck access, dock-high loading for tractor trailers, and some at-grade docks for smaller trucks. Modern airside facilities offer sufficient space for truck and trailer maneuvering/parking, as well as ample private vehicle parking for staff. All modern airside facilities must be truly intermodal, providing the main conduit between air and surface transportation. Rather than being called warehouses, these are pass-through facilities.

10.1 Trucks

As already noted, trucks are an essential component in most air cargo operations and the integrated carriers rank among North America's largest trucking companies. Consequently, airport planners should design facilities that are readily accessible for today's long tractor-trailers and provide space within the leasehold for trucks to operate safely and effectively.

To allow trucks sufficient room to maneuver and park safely, a facility typically requires at least a 130-150- foot setback from the road. Space permitting, planners should allow for both queuing and, on a limited basis, parking. If the building operation does not involve aircraft, it can be tailored to the needs of the trucker. In a pure cross-dock facility, the building is much narrower and can be fit very well onto a site that otherwise may not be functional. However, much of the trucking activity on airports is not tracked, presenting stiff challenges for planners lacking the information and insight into actual roadway volumes, cargo volumes, and realistic space requirements. These same items also raise potential access issues.

10.2 Access

Back to Table of Contents

Given the inherent time concerns in air cargo operations, numerous access issues enter the site selection process.

- Airport Access vs. Market Access: does it make sense for the tenant to locate their cargo operation at the airport based on access to primary markets?
- Cargo Facility Access: do roadway geometry and airport traffic patterns lend themselves to locating a cargo facility, with its inherent truck traffic, at a particular site?
- Airside Access: is it necessary and possible for a tenant to bring an aircraft to the building site? What is the cost and allocation methodology for airside infrastructure (i.e., taxiway, ramp, etc.)?
- Tug Access: does a restricted service road reach the site or can one be built and again, how will costs be allocated?

11. Conclusion

This chapter defines the key stakeholders involved in air cargo facilities development, identifying potential areas of conflict and opportunities for collaboration. The primary participants in air cargo facility development are airport management, airlines, ground handlers, third-party developers, trucking companies, shippers, freight forwarders and customs brokers.

Prior to construction, airport management must undertake a thorough analysis to determine the market demand for a new cargo facility, assess the financial capacity to support the project, and identify potential stakeholders and users. This due diligence is essential to ensure the facility meets industry demands, attracts key partners, and delivers long-term value to the airport and its surrounding economy.

The decision to partner with a developer must be supported by a clear process of selection, followed by an operating lease that offers both sides an acceptable opportunity to meet their goals. Both sides must recognize the demands placed on the other. Airports are responsible to their local public, other tenants, and numerous regulatory agencies. Developers must be able to satisfy investors and ultimately their tenants. A successful partnership hinges on this mutual understanding and aligns expectations.

Fostering open communication and collaboration is critical to the success of cargo development initiatives. An Air Cargo Community (e.g., association, committee) a forum comprised of both on and off airport key cargo industry stakeholders, provides a platform for ongoing dialogue about industry trends, operational challenges, exchange of timely updates and collect valuable feedback. By encouraging transparency and shared learning, the committee supports a unified approach to navigating the evolving air cargo landscape and promotes more sustainable, efficient and responsive cargo operations.

At the same time, establishing well-structured and balanced lease agreements is essential to building successful relationships between airports, developers and tenants. Among the negotiable items are lease terms, applicable rates and charges and the review periods for possible escalation of the ground lease. Non-negotiable items include a broad range of control issues, including insurance, environmental protection, and security measures. Given the need to protect the airport from potentially damaging tenant bankruptcy proceedings, airport management will also attempt to control the usage, sub-letting and lease assignment of the facilities or area. As with any relationship, airport operators and their tenants must be flexible in their negotiations and respect the objectives held by the other party.

Above all, each party's concern must be clearly reflected in the final agreement. An ambiguous contract invites confusion, operational friction, and ultimately, breakdown!

Back to Table of Contents

Chapter 8

Airport Performance Benchmarking

Back to Table of Contents

1. Introduction – The importance of Performance Benchmarking to airports

Measuring airport performance is one key to successful and efficient management of airports. To help move toward a common performance benchmarking air cargo, the ACI-NA Air Cargo Committee promoted options that are presented in this chapter. Rather than a precise formula of ingredients, performance benchmarking means the process of identifying best practices, understanding their meaning in relation to business and adopting these practices to help airports serving the cargo industry improve their performance. Airport leaders may wish to evaluate their own performance internally over time, however, also observe externally at other comparable sized airports. Such external comparisons however are extremely difficult given the substantial differences that occur in air cargo operations at airports that from many business elements other than air cargo may be considered comparable.

For most airports, air cargo and its underlying business and operating dynamics are less understood elements of the aviation industry particularly by airport authorities. It is important to note that while several stakeholders are discussed in this chapter, it is written for airport leaders and their staff. The chapter identifies potential benchmarks to help leadership create a set of *airport-specific* criteria that will enable them to:

- Better understand and/or manage the business elements of air cargo, as they relate to their respective airport and
- Anticipate potential challenges to be more responsive to the unique service requirements of tenants and users and
- Select performance measures that are meaningful to their airports and enable them to reflect airport performance accurately to their respective authorities

The use of performance measures to compare one airport to another may have extensive variables, volatile industry dynamics and maybe subject to anomalies. It is important to establish performance measures that are not forced or inappropriate. The measures should address specific airport needs and not attempt to compare air cargo functions at large hubs vs mid/small hub gateways.

Airports play a prominent role in facilitating air cargo national and regional accessibility while driving the economies of the areas or regions served. Advances in technology and improvements in supply chain and intermodal transportation processes coupled with forecasted growth in the air cargo business have presented airports with many challenges. These include operational efficiency, cost effectiveness and security. Linking the business process to customer needs is an essential part of benchmarking. This concept becomes increasingly important to airports as stakeholders along the air cargo logistics chain continue to demand benchmarking activities of interest to their various customers. Achieving performance standards can be the deciding factor when determining to whom to award business or how to route air cargo in or out of a region. Internally, Airports should know their competitive position in the market.

By establishing performance benchmarks, airports can develop a better understanding of both individual performance of stakeholders, as well as the overall performance of the airport versus benchmark standards and goals.

2. Performance Benchmarking

Performance benchmarking is the practice of comparing processes and performance metrics to industry best practices from other entities. Dimensions typically measured are quality, time and cost.

Benchmarking is used to measure performance using a specific indicator (cost per unit of measure, productivity per unit of measure, cycle time of x per unit of measure or defects per unit of measure) resulting in a metric of performance that is then compared to others.

3. Stakeholders

Stakeholders can be defined as people or organizations that have some interest in airports as they pertain to air cargo. Airport stakeholders can include the airport governing authority, shareholders, employees, airlines, customers, the public, members of the local community, government agencies, industry organizations, ground handling agents, freight forwarders, surface transportation providers, U.S. Customs Brokers, security companies and other related vendors and service providers.

Back to Table of Contents

4. Conditions of measurement

Effective benchmarking relies on f focusing on what needs to be measured and the processes involved when measuring performance, core practices and competencies, accessibility, accuracy and reliability.

Performance relates to results and differences of various outputs. Performance measures have the responsibility of accommodating the needs and requirements of all airports, regardless of size or volumes. Performance measures should be accessible, reliable, dependable and accurate. It is essential that they are consistent and identical, whether in the comparison between airports or in an airport's efforts to recognize the value of its own air cargo operations.

Core practices and competencies refer to how these processes are conducted and performed to achieve this output.

Accessibility pertains to the ability of data to be obtained and gathered on a reasonable basis. This may be the most challenging aspect of many air cargo measures for which data are frequently tracked and reported very differently by the various stakeholders.

Airports should evaluate the accuracy and reliability of their internal data and the data received from their stakeholders. Reliability will ensure that what is measured is truly what an airport has intended to measure. Dependability provides a consistent result throughout the continued measurement process or within designated time frames. Accuracy ensures a basis of completion and that the measurement is available for its desired uses.

5. The Benchmarking Process

Benchmarking requires a process that airports can follow to satisfy its individual requirements and is not a one-time event and needs to be maintained to ensure continuous improvement.

5.1 Goals and Implementation

The first phase in the benchmarking process consists of establishing a plan to include goals and objectives. This is the most arduous task and requires the identification of:

a) management and customer needs, and

b) the manageable core processes at each airport that can address those needs

Some airports may decide that they only require very basic or simple benchmarking criteria where others need a more sophisticated menu. Prioritizing of metrics should be based on the airport's individual strategic goals and objectives. During this phase, it is necessary to obtain a full understanding of critical processes and the means they are measured. The airport must then decide what data is required and the method of collecting this data. Defining the process is necessary, as this will lead to goals, inputs, outputs and measures for success being identified. Identifying the most critical issues will subsequently allow for determining any opportunities for improvement. The use of flowcharts and other graphic aids may aid in simplifying the process.

5.2 Selection of Peer Airports

If airport management opts to compare its airport to others, then determining which airports to benchmark against is the critical second phase of the process. Selecting inappropriate peer airports can lead to erroneous conclusions about the performance of your airport, so the selection of truly comparable peers is essential. Finding airports that are truly comparable is a challenge. Basic cargo characteristics such as volume, the mix of operations (belly freight, dedicated freighters, integrated carriers, eCommerce operations), airport capacity and utilization should of course be similar. But even then, airports that may seem similar with respect to cargo may not be comparable (or compared with caveats) because of something not directly related to cargo. These other factors may include the ownership and governance structure, the competitive environment, the economic regulatory structure and the mix of traffic. For example, a cargo-only airport (or an airport with limited passenger activity) needs to cover all its costs through charges for cargo and its tariff will reflect that. Airports with large passenger volumes can cover more of the common costs from passenger charges or non-aeronautical revenues.

Back to Table of Contents

No group of peer airports will be an exact match (if you have seen one airport, you have seen one airport). However, care in selecting peers that are as comparable is key to providing meaningful results.

5.3 Data Collection

The third phase in the benchmarking process concerns the collection and methods of data used to achieve this function. Research must be conducted to identify the metrics that will be used, to select candidates for the benchmark process and to subsequently collect the data used in the benchmarking performance process. The understanding of an airport's core competencies and processes is essential to the success of this phase. When selecting organizational partners or candidates to benchmark against, it is important to consider factors such as cost, time, logistical efficiencies and any previous relationships. An obvious selection would be to look within the same industry, an industry that is closely related to the operation of an airport or involved in the transport of air cargo. The actual collection of data can be achieved in a variety of ways, the most common are checklists, surveys, interviews, questionnaires and published carrier or government data. The collection of data should be conducted in a uniform manner to ensure consistency.

It is vital that an airport understands its data accuracy and sources; otherwise results may be skewed. An example may be with air cargo facility capabilities regarding terms of space, tonnage throughput and financial implications. Some air freight processed in a warehouse may not be enplaned or deplaned at that specific airport but will be trucked from or from another airport (road feeder service). This air freight is not reported on the FAA T-100 "Air Carrier Traffic and Capacity Data by Non-Stop Segment and On-Flight Market" (and therefore not included in any statistical figures that might be measured). Ensuring that an airport is aware of relevant data and capturing it accurately is necessary for usable results. Continuous improvement to the collection process should also be mandated. Consideration of confidentiality as organizations may consider certain information and data to be sensitive and for internal uses only is also critical in this step. Reciprocity should also be considered, as this will provide a level playing field for organizations involved in the process.

5.4 Analysis

Analysis of the data collected is the fourth step in the process. The results should be analyzed to determine where there are any gaps between the airport's processes and those that have been used for benchmarking purposes. This analysis can be conducted within various time frames, depending if an airport is looking for quick view or focusing on long-term trends. From this information, strategic planning can be employed to make improvements to the processes. Understanding the reasons why and how the achievement of benchmarks can be accomplished will determine the root cause of any problem areas and allow for subsequent modification and improvement.

5.5 Adaptation

The final phase of the benchmarking process is specifically linked to the adaptation of the best practices defined and continuous improvement practices. Support of the various stakeholders involved in the process is necessary to ensure the application of the newly acquired best practices. This can be achieved through effective communication to the relevant parties involved. Goals can then be set and an action plan implemented to address the task of closing gaps and instituting processes for continuous improvement.

6. AREAS OF PERFORMANCE MEASUREMENT

To clearly define areas of performance management where benchmarking initiatives can be conducted, it is necessary to identify the core competencies of airports as they relate to the air cargo industry. These core areas are identified as Security & Safety, Facilities, Airport Infrastructure, Cargo Throughput and Flight Activity, Service Levels, Financial Implications, Economical Implications, Business Development and Marketing.

Security & Safety pertains to government regulations & measures, industry regulations & measures, and internal regulations & measures that will ensure that airports meet and exceed minimum standards.

Facilities involve all aspects of cargo facilities including size, occupancy, throughput capabilities, efficiency, aircraft parking, automation and age.

Airport Infrastructure relates to AOA capabilities such as runway dimensions and capacity, ramp, and types

Back to Table of Contents

of aircraft handled. It also includes landside transportation access capabilities.

Cargo Throughput and Flight Activity refers to the volume of cargo handled at an airport, the types of cargo an airport handles and the volume of flights in and out of that airport.

Cargo Service Levels refer to the various landside and airside operations that relate to air cargo.

Financial Implications refer to the various fees and revenues that airports realize from air cargo.

Economic Implications refer to the economic vitality of the airport and airport region because of jobs created, wages earned and revenue produced.

Business Development and Marketing encompass a wide array of Airport functions including marketing and planning.

6.1 Performance Measures

Included below are listings of potential measures that airports could utilize. Not all of these would be meaningful to every airport. Airports can also create derivatives of the measures listed to suit their specific benchmarking needs that most clearly relate to their own management, internal and external reporting requirements.

Security & Safety

Activity	Benchmark	Target	Results	vs. Bmark
Availability of Police Escort for High Value Cargo				
Percentage of Cargo Operations Area as SIDA				
Does the Airport Meet TSA Requirements				
Does the Airport Meet FAA Requirements				
Dollar value of cargo lost to theft.				
Dollar value of U.S. Customs fines				
Number of incidents of theft.				

Facilities

Activity	Benchmark	Target	Results	vs. Bmark
Facilities (Total)				
Number of Facilities				
Warehouse Square Feet (Total)				
Office Space (Total)				
Ramp Space (Total)				
Aircraft Parking Positions (Total)				
Truck Bays (Total)				
Warehouse Occupancy/Vacancy Percentage				
Warehouse Condition				
Warehouse Capabilities (Automated)				
Warehouse Capabilities (Semi-Automated)				

Back to Table of Contents

Warehouse Capabilities (Non-Automated)				
Truck Parking Positions				
Customer Parking Spaces				
Employee Parking Spaces				
Average Age				
Warehouse Throughput per Square Foot				
Warehouse Throughput per Square Foot vs. PY				
Facilities (Individual)				
Warehouse Square Feet				

PY- Previous Year

Airport Infrastructure

Activity	Benchmark	Target	Results	vs. Bmark
Efficiency of Cargo Area Access				
Efficiency of Airport Roadway Access				
Efficiency of Airport Cargo Area Access				
Efficiency of Aeronautical Infrastructure				
Number of Runways				
Condition of Runways				
Size of Runways				
Capabilities of Runways				
Total Aircraft Parking Spots				

Cargo Throughput and Flight Activity

Activity	Benchmark	Target	Results	vs. Bmark
Annual Cargo Throughput				
Annual Cargo Throughput vs. PY				
Annual Cargo Throughput per Carrier				
Annual Cargo Throughput per Carrier vs. PY				
Annual Cargo Throughput per Facility				
Annual Cargo Throughput per Facility vs. PY				
Annual Cargo Throughput per Facility not Flown				
Annual Cargo Throughput per Facility not Flown vs. PY				
Annual Cargo Throughput (Freighter Aircraft)				
Annual Cargo Throughput (Freighter Aircraft) vs. PY				
Annual Cargo Throughput (Passenger Aircraft)				
Annual Cargo Throughput (Passenger Aircraft) vs. PY				
Annual Cargo Throughput Passenger vs. Freighter Aircraft %				

Back to Table of Contents

Annual Cargo Throughput Passenger vs. Freighter Aircraft % vs. PY				
Annual Cargo Throughput Domestic Cargo				
Annual Cargo Throughput International Cargo				
Annual Volume of Flights (Total)				
Annual Volume of Flights (Total) vs. PY				
Annual Volume of Flights (Freighter Aircraft)				
Annual Volume of Flights (Freighter Aircraft) vs. PY				
Annual Volume of Flights (Passenger Aircraft)				
Annual Volume of Flights (Passenger Aircraft) vs. PY				

PY- Previous Year

Cargo Service Levels

Activity		Benchmark	Target (%)	Results	% vs. Bmark
Landside	Truck Waiting Time				
	Cargo Delivery				
	Document Delivery				
	Cargo Availability				
	Empty ULD Pickup & Delivery				
Warehouse	Breakdown (General Cargo)				
(Import)	Breakdown (Perishable Cargo)				
	Breakdown (Express Cargo)				
	Irreg Handling (No Locate)				
Warehouse	Build-up (General Cargo)				
(Export)	Build-up (Perishable Cargo)				
	Build-up (Express Cargo)				
	Irreg Handling (Wrongly Forwarded)				
	Irreg Handling (Short-shipped)				
	Irreg Handling (No Locate)				
Warehouse (Transfer)	Aircraft to Aircraft				
Airside	Aircraft Handling (Unloading)				
	Aircraft Handling (Unloading)				
	Aircraft Handling (Turnaround)				
Dwell Time	Transient (technical & fueling) activity				

Back to Table of Contents

	Cross loading pallets/containers				
	Partial breakdown/buildup				
	Full breakdown/buildup				
	Partial sortation				
	Full sortation and customs clearance traffic				

Financial Implications

Activity	Benchmark	Target	Results	vs. Bmark
Freighter Landing Fees				
Passenger Aircraft Landing Fees (per Cargo Wgt %)				
Percentage Fees on Revenues				
Fuel (Into Freighter Aircraft) Fees				
Fuel (Into Passenger Aircraft per Cargo Wgt %) Fees				
Revenue from Facility Leases				
Aircraft Parking Fees				
Total Revenue from Cargo				
Cargo Revenue vs. Total Airport Revenue				
Total Investment in Cargo				
Revenue per Cargo Facility				
Revenue per Ton				
Revenue per Warehouse Square Foot				
Revenue from International Carriers				
Revenue from Domestic Carriers				
Vs. Previous Year				
Freighter Landing Fees				
Passenger Aircraft Landing Fees (per Cargo Wgt %)				
Percentage Fees on Revenues				
Fuel (Into Freighter Aircraft) Fees				
Fuel (Into Passenger Aircraft per Cargo Wgt %) Fees				
Revenue from Facility Leases				
Aircraft Parking Fees				
Total Revenue from Cargo				
Cargo Revenue vs. Total Airport Revenue				
Total Investment in Cargo				
Revenue per Cargo Facility				
Revenue per Ton				
Revenue per Warehouse Square Foot				
Revenue from International Carriers				

Back to Table of Contents

Revenue from Domestic Carriers				

Economic Implications

Air Cargo Economics	Benchmark	Target	Results	% vs. Bmark
A. Direct Jobs Created				
Jobs per Investment Dollar				
Jobs per Cargo Short Ton				
Jobs per Average Truckload				
Total Wages				
Average Wage				
B. Indirect Jobs Created				
C. Total Economic Activity				

Business Development

Activity	Benchmark	Target	Results	% vs. Bmark
Creation of an Air Cargo Master Plan				
New Construction Initiatives				
Volume of Innovation Initiatives				
Marketing Initiatives and Venues				
Business Development Initiatives				
Creation of and Air Cargo Marketing Plan				

7. MEASUREMENT AUDITING

Performance benchmarking is an ongoing process that allows each airport to decide on its own levels and indicators of measurement, the intervals and time frames relevant to that airport. Performance benchmarking activities can be conducted monthly, quarterly, bi-annual and yearly intervals depending on the resources and requirements of the individual airport. It is recommended that airports measure performance as dictated by the needs of the specific performance measurement area that is involved. For example, air cargo service levels may need to be measured more frequently than economic implications. It may also be necessary for airports to incorporate these activities into their annual planning and budgeting forecasts to ensure that resources are available to conduct performance benchmarking.

Scheduled auditing of performance is also important to ensure that the performance measures in use remain useful, relevant and that the related business strategy remains unchanged. In addition, when auditing performance, it is just as important to reassess the industry context as a double checking for relevancy. For example, if the airport targeted five (5) percent annual growth in air cargo tonnage for the year, and by mid- year growth was at six (6) percent, the tendency is to believe that the airport is doing well. If, however, industry growth is at nine (9) percent, then the strategy may need to be reassessed. In contrast, if targeted growth were five (5) percent and airport growth were for in an industry that grew only two (2) percent, then the perception of performance typically would not be negative even though targeted growth was not achieved. This is often an extremely important message to convey to stakeholders.

7.1 TARGETING THE MEASURES

In July 2005, the ACI-NA Air Cargo Committee attempted to refine the large listing of measures by surveying a wide range of constituents including airports of varying sizes, developers of air cargo facilities, consultants and various supporting services. The effort identified a list of generic measures that could be used to

Back to Table of Contents

compare air cargo performance across airport lines. This information is helpful in identifying a broad industry-wide perspective:"Top Ten" generic measures:

1. Metric Tons of cargo enplaned and deplaned (annually)
2. Metric Tons of cargo enplaned and deplaned (annually) – International Belly vs. Freighter
3. Metric Tons of cargo enplaned and deplaned (annually) – Domestic Belly vs. Freighter
4. On-airport warehouse square footage (total)
5. Number of direct jobs created from air cargo activity
6. Average custom clearance time
7. Air cargo facility throughput per square foot
8. Efficiency of cargo area access
9. Efficiency of aeronautical infrastructure
10. Air cargo facility occupancy/vacancy percentage.

Several of these measures are common use throughout the industry and serve as valid volume comparisons, however some of the measures do little to benchmark the efficiency or effectiveness of one airport's operation versus another airport. Given the variation in cargo operations, two sets of measures may be considered.

1. The first is for the airport to use, in the day-to-day management of the cargo operation. These are the internal measures: they reflect feedback from existing tenants measured against airport goals and are more narrowly focused.
2. The second set reflects broader reporting issues that are most appropriately used for external reporting and to compare the airport's performance to other comparable airports. These recommended measures have also been derived from the goal structure of the cargo program.

The measures and benchmarks should be structured in such a way that the airport will be able to develop data that will enable management to better understand existing cargo operations and proactively manage future cargo growth strategies. They are listed in a suggested priority order. Airports have historically tended to focus on macro-measures that are more generic to tonnage or operations. All the following measures can be implemented without major challenges. The decision of who will perform the measures and exactly how they will be measured and to what standards, will depend on the creation of such standards by the airport and its authority.

Internal management measures and benchmarking

1. **Volumetric measures:** These are the typical measures used throughout the industry dealing with tonnage and operations. They can be subset into inbound-outbound, domestic-international and freighter-belly cargo. Reports should be structured so that data can be used to identify trends, anomalies and planning issues, as well as providing routine reporting data. It should be noted that this number may also be looked at in conjunction with regional market share if there are other airports in the close region.
2. **Cargo revenue generation:** The ability of the airport to generate revenue from cargo is important. Realistic targets should be based on a methodology that considers tenant and user operating conditions, value for services provided by the airport and coverage of airport cargo operating costs. These targets can be subset into landing fees, fuel flowage fees, leasing revenues, percentage agreements and other cargo-related fees.
3. **Occupancy rates of cargo facilities:** Recognizing that revenue generation is an important issue for airport leaders and non-aeronautical revenue. Facilities management and vacancy rates of the facilities should be monitored on a regular basis. The rates should be linked to the market, overall occupancy, revenue targets and FAA mandated appraisals that would be met as a result of leasing.
4. **Utilization of cargo facilities:** Management should establish utilization ratios that reflect targeted throughput for cargo facilities. Effective management of tenant occupancies is more cost effective than the development of new buildings. Monitoring cargo building throughput on a regular basis will help

Back to Table of Contents

management to identify the need for new space or opportunities to relocate tenants on a timely basis. It will also enable management to identify underutilized facilities.

5. **Availability of cargo facilities and infrastructure to meet demand:** It is critical that new infrastructure and facilities be timed to come online, or older facilities become available, to meet demand. This requires the establishment of development triggers and close management of the leasing portfolio.
6. **Utilization of the land envelope:** Land is the scarcest resource available at most airports. The amount of unused property available for cargo development is an important aspect in measuring present and long-term capacity.
7. **Compatibility of facilities and infrastructure with tenant needs:** The mere availability of cargo facilities is not enough. Warehouses that cannot accommodate throughput, screening or storage requirements will heighten levels of tenant dissatisfaction and in some instances will cause tenants and users to seek other airports. The same is true if tenants cannot access ramp (apron), lack sufficient truck staging or docks.
8. **Levels of tenant satisfaction:** The size of the regional cargo community warrants attention to the needs of this enormous contribution of revenue and jobs. Communications, responsiveness to tenant operating and maintenance needs, as well as administrative effectiveness are elements of business with which tenants and users are concerned.
9. **Efficiency of landside access and egress:** Cargo is inter-modal. An efficient operation must accommodate trucking requirements to and from the airport and to and from the cargo facilities. Many critical elements of an air cargo operation are located off-airport. Time from off-airport facilities to on-airport properties is a vital criterion as is the ability to exit the airport to the highway system and proximate regional destinations.
10. **Reported incidents of theft:** While a great deal of focus is given to anti-terrorism, a major concern for the air cargo industry is theft. This affects insurance premiums and can result in penalties to parties involved in the movement of goods. Airport management can help control theft through effective building planning and design, appropriate physical separations and assigned security personnel. Tenants can help control access based on the security protocols and lease parameters. A measure for this is also the dollar value of goods lost to theft. While this is a reasonable measure it should reflect any incident as a percentage of total dollar value of airport traffic.

External management measures and benchmarks

1. **Regional Economic Impact:** The total impact of the air freight business on a region is frequently surprising and often justifies investment beyond pure financial return on investment.
2. **Job generation:** Part of the justification for investment in air cargo operations is the number of jobs generated by cargo. This could be a subset of Economic Impact but can also be a standalone measurement.
3. **Volumetric measures:** These are the typical measures used throughout the industry dealing with tonnage and operations. They can be subset into inbound-outbound, domestic-international and freighter-belly cargo. Reports should be structured so that data can be used to identify trends, anomalies and planning issues.
4. I**nvestment in cargo facilities and operations:** Air cargo is typically a lower profile aspect of an airport's operation than the passenger business. It does generate substantial benefits. It will be important to be able to indicate levels of investment in cargo to put generated benefits in context.
5. **Cargo Revenues:** This number can be expressed in total or as a percentage of total airport revenues. Total revenue should include landing fees, fuel flowage fees, leasing revenues, percentage agreements, and other cargo-related fees.
6. **Total developed cargo facilities and infrastructure:** Airports, particularly those considered "gateways" are frequently compared based on their overall capacity for airside and landside cargo operations.
7. **Levels of tenant/user satisfaction:** The size of the regional cargo community warrants attention to the needs of this enormous contributor of revenue and jobs. Communication, responsiveness to tenant operating and maintenance needs, as well as administrative effectiveness are elements of business with

Back to Table of Contents

which tenants and users are concerned. Tracking must lend itself to the formulation of key issue analyses and appropriate outreach and corrective initiatives.

8. **Appearance:** The aesthetics and overall appearance of facilities and the air cargo zones in general are key marketing tools for attracting new tenants or retaining existing ones.

Performance measures should provide meaningful information about what they are intended to measure. The effectiveness of a cargo leasing program is not best measured by the amount of square footage under lease. Airport management is usually just interested in the revenues generated by the leasing program. It is therefore important to measure not just the amount of square footage but also the rate per square foot at which the property is leased. Similarly, service improvements are important in the public sector, but the cost-benefit must be considered and alternatives evaluated.

8. CONCLUSION

Performance benchmarking is an integral part in the continuous improvement of any organization's effectiveness. From an airport's perspective, it links goals to the needs of customers, stakeholders and to the airport itself. If an airport is looking to improve its internal operations or to become more competitive on an industry-wide basis, understanding best practices and utilizing them is essential to future prosperity and growth.

Back to Table of Contents

Chapter 9

Security

Back to Table of Contents

Back to Table of Contents

1. Introduction

The definition of "Cargo Security" has greatly evolved over the past decade. Where theft was once the focus of an airport's cargo security program, the acts of September 11, 2001, and other terrorism-related threats and incidents have changed the scope of cargo security forever. The new definition of cargo security pertains to the safety of aircraft and the safeguarding of aircraft from terrorism-related activities. As mandated by The Department of Homeland Security (DHS), the Transportation Security Administration (TSA) has set forth approved security programs for airports to implement and follow. Although cargo theft remains an important consideration in today's cargo security arena, this chapter will focus on the requirements of Title 49 in the Code of Federal Regulations, Chapter XII, Subchapter C, Part 1542 on Airport Security. Part 1542 contains specific requirements which must be contained in the airport security program including the areas of access control, SIDA (Secure Identification Display Areas) and AOA (Air Operations Areas).

Historically, air cargo consisted of time sensitive or high-value products for which the higher cost of shipping by air represented a realistic trade-off for security and speed. Recognizing that the growth of the industry would in large part be linked to the protection of goods, air cargo security evolved as a loosely coordinated, inconsistent, but relatively efficient series of physical and administrative elements focused on the prevention of theft. The resultant business systems and physical infrastructure of modern goods movement in general were designed to reduce the potential for theft of goods by individuals within the employment envelope or by an external source.

Security remains at the forefront of an airport's air cargo agenda and requires constant vigilance and continuous monitoring of the rules and regulations set forth by our lawmakers and government regulatory agencies. To gain a working understanding of an airport's role in air cargo security, we will look at this topic from an airport management perspective and ask four basic questions of ourselves.

Cargo Screening – The Bottom Line

Under the current regulations, cargo screening has been delegated to the air carrier or an approved agent by the TSA. The airport has no direct role in the screening of cargo and remains a support function as described in the initial section in this chapter. Critical elements include access control, perimeter security, vehicle security and control and detection of unauthorized individuals on the airport, badging, background investigations and emergency law enforcement response. The TSA will enter into voluntary agreements with airports to test new cargo screening technologies. In these cases, the airport provides facilities and support, but the cargo screening function and responsibility remains with either the TSA or the approved private entity.

The Role of the Airport Security Coordinator

Each airport must identify at least one Airport Security Coordinator (ASC) who serves as the primary point of contact with the TSA and has the power to implement immediate corrective action in the case of violations of security requirements. This Airport Security Coordinator must be available on a 24-hour basis. These requirements are contained in TSA regulations. Most airports also identify alternate Airport Security Coordinators to serve as backups for the primary ASC. It is important that the ASC maintain an ongoing operational dialog with the TSA Federal Security Director to ensure a highly functional security capability at the airport. Good security is a function of cooperation and collaboration at the airport level.

The Importance of the Federal Security Director

The relationship between an airport manager, the Airport Security Coordinator and their Federal Security Director is extremely important. All significant security measures, procedures and changes must be reflected in the Airport Security Program and approved by the Federal Security Director. The maintenance of ongoing communications and an appreciation of each other's roles are central to making this a mutually productive and beneficial relationship.

The Terrorism Threat

In its Air Cargo Security Notice of Proposed Rule Making (NPRM), which TSA published prior to issuing extensive regulatory changes, two critical risks were identified in the air cargo environment:

- the use of cargo to introduce an improvised explosive device aboard a passenger aircraft
- the hostile take-over of an all-cargo aircraft for use as a weapon

Back to Table of Contents

The magnitude of these risks was considered in view of credible threats and possible vulnerabilities. Extensive comments were received regarding the threat and proposed countermeasures from the time the NPRM was published on November 10, 2004, and the issuance of the Final Rule on May 26, 2006.

Terrorists have attempted to attack aviation via air cargo in the past and aviation continues to be a priority of terrorists. Past related incidents include:

- On American Airlines flight 444, a Boeing 727 flying between Chicago and Washington, DC, an Improvised Explosive Device (IED) constructed by Ted Kaczynski, the convicted "Unabomber," began smoking due to a reaction in the explosive. The pilot made an emergency landing.
- In 1995 following his attempt to place leave-behind IED's on U.S. carriers flying in Asia, Ramzi Yousef constructed two IED's to be placed in cargo on board two U.S. carriers flying from Bangkok to the U.S. Upon arriving at the airport, one of Yousef's co-conspirators was intimidated by the array of security measures in place at Bangkok and was deterred from attempting to introduce the IED's as cargo.
- In 2010 explosives were shipped from Yemen disguised as printer cartridges. While the aircraft was not the target, this did increase the call for cargo security. It should be noted that this plot was foiled by intelligence gathering and not by cargo screening technology.

2. Background

Since the Gulf War in 1991, more carriers and airports have placed increasing emphasis on air cargo as a key component of their overall revenues. In the case of airports, cargo capacity has become very important in the generation of jobs and has become a major factor in the economy leading to the location/relocation of large regional logistics and distribution facilities. Airport facilities and infrastructure have been designed to accommodate and encourage cargo growth even at airports that are geographically constrained. Carriers have established separate lines of business, unique route structures and capital investment at select airports to meet cargo revenue and service objectives.

An expanded focus on security applications to include both anti-theft and anti-terrorism has had a substantial impact on all segments of the industry. It has impacted the financial viability of several carriers and airports. Because of the events of September 11, 2001, a decision was made to prohibit mail weighing more than 16 ounces from flying as "belly" cargo. In October 2002, the Senate Committee on Commerce, Science and Transportation on estimated a $90 million revenue loss to the passenger carriers in the twelve-month period to September 2002.[5].

After September 11, 2001, cargo activity was immediately impacted and the financial stability of the entire aviation industry was compromised. Critical impacts included:

- Loss of airport revenue
- Loss of airline revenue
- Increased use of trucking
- Increased use of freighters
- Permanent escalation of insurance costs
- Consolidation among smaller firms
- Failure of smaller support firms
- Failure of many small cargo airlines
- Higher operating costs because of security
- Longer processing time because of security
- Increased available freighter capacity driving down rates

The air cargo industry has an enormous supporting business infrastructure of small, medium and large size firms that tend to cluster around major gateways or large shipping hubs. These firms include customs brokers, freight forwarders, container freight stations and consolidators; all of which are directly involved in the landside elements of shipping. These are the firms that work as direct links between air carriers, shippers

Back to Table of Contents

and consignees. They are also the firms that generate and control substantial portions of the paperwork (or electronic documentation) associated with shipping.

[5] http://www.gpo.gov/fdsys/pkg/CHRG-107shrg92436/html/CHRG-107shrg92436.htm

3. The Parties Involved – Basic Roles

3.1 The Airport

The most basic role of the airport is that of a landlord. It provides the land on which the aircraft operators land and take off and provides and controls access to those parties wanting access to the aircraft. The airport is in the business of providing aircraft operators the rights to use the land. Implicit in the role of providing access is the role of controlling access. That is, restricting the access of certain individuals at certain times, based on specific criteria. It is at this point that the airport's primary operational function and primary security function become identical: access control. This holds true for cargo security as well as aviation security in general. In the largest sense, this includes other perimeter security measures, including fences; doors and gates; employee and vehicle identification systems; and law enforcement response.

It must be emphasized that access control is not an end in itself. It is a tool by which important assets are protected. In the past, the primary asset in need of protection was the passenger aircraft to prevent hijackings and the introduction of explosive devices. More recently, it has been recognized that those areas of the airport where cargo is handled and stored must be protected to prevent the introduction of explosive devices and/or hijackers in cargo.

True access control has three critical elements:

- access by unauthorized individuals must be prevented or deterred;
- unauthorized access of the protected area of the airport must be detected; and
- those persons or vehicles who have gained unauthorized access must be apprehended.

It is a triad of responsibilities which comprise the single function of access control. All these functions must be formalized, documented and assembled in a single document known as the Airport Security Program.

Overlaying these several operational security functions of the airport, however, is a larger security function which, though not required by regulation or law, is of paramount importance. The airport must create a culture of respect and involvement for security. This is a management function that cannot be overestimated. The management of respect and consideration for airport security (including air cargo security) creates a top-down attitude that tends to pervade airport management and all tenants and organizations that belong to that airport community. A management attitude that is respectful of security ultimately results in an airport environment that is safe, orderly and secure – an environment that is unattractive to individuals or organizations that are planning to conduct a terrorist attack.

3.2 Aircraft Operators / Air Carriers

Historically, in the scheme of cargo security it is the air carrier, most particularly the passenger air carrier that has been the target for terrorist attacks. However, it is not only the air carriers that are the target, but the passengers traveling on a particular air carrier. It is the combination of passengers with an air carrier that are identifiable with a particular country or political entity that makes it the target. In this two-element target, the passengers may serve as hostages or victims of a terrorist event. In the 9/11 attacks, the air carriers served not as the target but as the tool or instrument of the mission; the terrorist targets becoming more prominent political assets/symbols or a significantly larger group of victims. It is the presence of the air carriers at the airports that create the need for airport security.

Belly Carriers

The passenger airlines, for which cargo often represents the margin of profit on many routes, experienced decreases in both capacity and demand following the 9/11 terrorist attacks. On the airside, the effects were immediate:

1. The number of commercial flights was dramatically reduced. At hub airports, operations dropped as much as 27%. The resultant loss in belly cargo capacity forced the diversion of cargo to trucking, freighter

Back to Table of Contents

and integrator traffic.

2. The TSA restricted the nature of cargo that could be carried in passenger aircraft. This also accelerated the diversion to other modes of transportation.
3. Carriers in many instances reduced the size of the aircraft, lowering operating costs, but also reducing belly capacity.
4. Restrictions on the amount of personal possessions that passengers can carry on board forced additional baggage into the bellies and further reduced available capacity for freight and mail.

The fundamentals of the goods movement infrastructure has shifted and the result will continue to impact the nature of and demand for relevant airport facilities.

Freighter Operators

Freighter operators were the initial beneficiaries of the system's diminished belly capacity. Generally, security requirements are less stringent for these carriers, enabling them to capture a greater percentage of the market. With most wide-body freighter operations focusing on international traffic, the challenge is to establish a level of confidence with security controls at international shipping points, given the almost limitless shipping points from which freight can originate. The imposition of unilateral security standards on a global basis is not immediately practical or politically viable, and restrictions on carriers or points of origin may appear arbitrary and be deemed an undue constraint of trade. It should be noted that the integrated carriers established very stringent security measures.

Indirect Air Carriers

An Indirect Air Carrier (IAC) is not an air carrier at all and may not have an U.S. Federal Aviation Administration's (FAA) Operating Air Carrier Certificate. An IAC does not typically operate or possess aircraft to carry cargo, but arranges for the goods of another company to be transported by air. It is, in essence, an air freight travel agent. It is a middleman in the chain of operations and security for cargo. It is an important operation since the integrity of cargo must be ensured from its origin at a trustworthy shipper to its loading in the secure cargo hold of an aircraft. IACs are not granted operating certificates by the TSA in the same way that airports or air carriers are granted certificates by the FAA. IACs are granted approvals to operate and conduct business in accordance with their approved security programs (e.g. U.S.'s Indirect Air Carrier Standard Security Program: IACSSP). IACs are regulated under 49 CFR 1546 and there are over 5,000 IACs in the U.S. alone.

Shippers

The term shipper is not defined in the TSA regulations. It is generally understood to mean the individual or entity that originates and tenders cargo for air transportation. The shipper, via ownership of the cargo, has the authority to move it, ship it or possess it. Shippers are viewed as the initial point in the air cargo supply chain. In some cases, a shipper may utilize the services of a warehouse operator or other third party to store their products. In this case, the shipper remains the entity that owns the cargo and initiates its shipment. In such a case, the warehouse operator would be acting as an agent of the shipper and the security measures of the warehouse would need to be equal to or greater than the measures required of the shipper. While shippers are not directly regulated by the TSA, they are indirectly by the guidelines imposed on air carriers and IACs.

Shippers are currently divided into categories of "Known Shipper" and "Unknown Shipper." Cargo that is initiated by an Unknown Shipper is subjected to greater security measures than cargo from a Known Shipper. The concept is that a company or person that has established itself as "known" over a period in business is not an enterprise set up by terrorists to place an explosive onto an aircraft. This concept is valid if the shipper maintains an effective ongoing Personnel Security Program and maintains a high level of integrity among its employees that have access to cargo. The requirements that determine whether a shipper is a Known Shipper or Unknown Shipper are protected as Sensitive Security Information and are described in the approved security programs of aircraft operators and IACs. Currently in the United States, cargo from an Unknown Shipper is not allowed to be transported on a passenger aircraft. In other portions of the world, it is subjected to additional levels of security and inspection.

Trucking Companies and Couriers

Trucking companies and couriers are not directly regulated by the TSA. They are controlled indirectly by the TSA via the regulations and security programs of the air carriers and IAC. The air carriers and IAC must ensure

Back to Table of Contents

that entities acting as their agents (in this case trucking companies and couriers) abide by the conditions placed upon them. In general, violations of security requirements by an agent of a regulated party are the responsibility of the regulated party. Contractual agreements between a regulated party and their agent can shift the monetary penalty to the agent but the regulated party remains responsible.

A substantial amount of air cargo (as much as 25% of the cargo volumes at an airport) moves on trucks either as origin and destination freight, or as truck-to-truck freight; based on current means, this goes unreported. Over the past decade, for financial reasons, freight has continued to be diverted to trucking when possible. Nevertheless, the truck/air relationship remains intact if somewhat diminished. It is likely that new security requirements will involve the implementation of higher levels of screening technology, greater processing costs and possibly lengthier processing times. From an airport planning perspective, some of these have already translated into a separate screening facility, modifications to an airport's infrastructure to include separation of truck and passenger vehicle traffic to and/or on the airport, further separation of vehicles in the air cargo areas and modifications of the buildings and surrounding roadways to allow for a smooth flow of vehicles, easy truck parking and minimal potential obstructions caused by queuing.

Added security requirements may affect the flow of cargo at an airport. In some instances, trucks may be required to move to a holding area for more detailed inspection. More typically, additional space may be required for vehicles queuing for routine inspections. Any delays of arriving trucks will create additional pressure on local shippers and forwarders to accelerate cut-off times and reduce their consolidation potential. Air cargo typically moves in well-defined shipping windows and most shipments are trucked to the airport as close to that window as possible. At international gateways, several hundred trucks could arrive at the airport over a two-hour period. For these trucks to be screened the delays could be extensive if the screening efficiency is not addressed. The problem can be exacerbated if the cargo is trucked over a large distance to airports with the specter of unknown screening delays waiting at the destination airport. Ideally, an airport will provide the space necessary to develop (as appropriate) effective central screening facilities that can eliminate much of the uncertainty. This will be a difficult task for some major gateways where land is the scarcest resource and connecting infrastructure is problematic to install. One potential way to help minimize these delays is a cross-referenced electronic identification program that links the driver to a vehicle. This has substantial potential, but given the nature of the industry, might be difficult to implement for all trucking.

The Regulation of Shippers, Trucking Companies, Couriers and Other Entities Not Specifically Identified

Airports, air carriers, foreign air carriers and IACs are generally considered regulated parties in that they are specifically subject to discrete regulations. However, in the recodification and reissuance of aviation security regulations following the 9/11 attacks, a new Part of the regulations was issued which applies to all persons engaged in aviation-related activities: 49 CFR 1540. All individuals and companies engaged in aviation-related activities are subject to and must comply with this regulation. This applies to airports, individuals, corporations, organizations, and groups of individuals regardless of nationality.

Examples of regulations in this Part include:

- 1540.103 states "No person may make or cause to be made and fraudulent entry on a document or application required in aviation security."
- 1540.105 states "No person may tamper, interfere with or attempt to circumvent any federally required aviation security measure.

A complete understanding of Part 1540 by all individuals involved in aviation security from the passenger to the airport manager is a prudent and recommended undertaking.

United States Transportation Security Administration (TSA)

The TSA has two major roles in the world of aviation security:

- It is a screening service provider, they conduct passenger screening, carry-on baggage and checked baggage screening.
- The TSA creates and regulates the security requirements for all parties involved in airport security and air cargo security. The TSA also issues regulations and criteria for security programs to include Security Directives, Emergency Amendments to Security Programs and Information Circulars.

Back to Table of Contents

In addition to these two primary roles, the TSA has several other roles supporting aviation and transportation security. TSA manages the Federal Air Marshall Program and the explosives detection K-9 program (these K-9 teams may be used to screen cargo under approved conditions). Effective November 1, 2018, TSA created the Third-Party Canine-Cargo (3PK9-C) Program, under TSA's regulations for Certified Cargo Screening Programs (CCSP), see 49 CFR part 1549, to provide an efficient and effective method for screening air cargo to TSA's standards. Under this program, third-party canine teams trained in explosives detection can be certified by a non-governmental entity, acting under the approval of TSA, as meeting TSA's certification standards. Certified 3PK9-C teams can be deployed to screen air cargo for aircraft operators, foreign air carriers and other TSA-regulated parties operating under a TSA-approved or accepted security program.

On May 18, 2018, TSA published a notice in the Federal Register seeking applications from qualified persons interested in becoming an approved 3PK9-C Certifier under the 3PK9-C Program. See 83 FR 23287. The CCSP-K9 security program defines the requirements that TSA-regulated canine explosives detection teams must meet when screening cargo for air carriers and screening facilities and will include eligibility requirements for canine explosives detection teams. These eligibility requirements for canine explosives detection teams include, but are not limited to, experience, education, vetting and citizenship requirements for canine team handlers. These eligibility requirements for canine explosives detection teams are not contained in the 3PK9 Certifier Order. The 3PK9 Security Program and Order are not available to the public as they contain information that cannot be publicly disclosed under 49 CFR part 1520. Individuals that complete the required vetting processes and other agreements necessary for release of Sensitive Security Information (SSI), including documenting a "need to know," will be provided a copy of the Order and Security Program.

Canine explosives detection teams were eligible to seek certification as early as November 1, 2018; however all teams should understand that successful completion of a 3PK9-C certification event is only one of the requirements for explosives detection canine teams under the CCSP-K9 security program. Among other requirements, the CCSP-K9 security program requires canine explosives detection teams to pass a background check before an air carrier may hire them to screen cargo.

The TSA also has a significant R&D organization that is involved in the testing of new technologies that may be implemented within transportation security including the screening technologies for cargo. The TSA has established a program to train pilots in the use of firearms in the cockpit environment. Many pilots have been trained and armed because of this program. The TSA also has responsibility for surface and rail security and maintains a cadre of inspectors that are tasked with this mission. Since air cargo security most often involves surface transportation this function of the TSA could well have a bearing upon air cargo security.

Finally, as an extension of its regulatory inspection function the TSA conducts security inspections of air carriers, including those that operate from foreign airports into the U.S. During these inspections, which are conducted at all locations in the U.S. where cargo is accepted for air transportation and at the international airports of departure, air cargo security measures are inspected.

International Air Transport Association (IATA)

IATA, while not strictly a regulatory body, does issue recommended security practices to its air carrier members. These practices focus mainly upon air carrier practices. Most IATA practices reflect the ICAO (International Civil Aviation Organization) Standards and Recommended Practices and the ICAO guidance material. IATA Recommended Practice 1630 applies to air cargo security.

United States Postal Service (USPS)

The USPS has developed a set of security procedures for ensuring the security of mail that travels by air. These procedures were established via mutual agreement between USPS and the TSA. As with the approved security programs of airports and air carriers, specific measures may not be disclosed to outside parties. However, an obvious example of these security measures is the prohibition to drop off mail packages greater than a certain size in unattended mailboxes.

4. The General Regulatory/Statutory Scheme

The TSA is the primary regulatory agency involved in establishing requirements for aviation security in general and air cargo security in particular. Since airports, aircraft operators, all-cargo carriers, IACs and shippers are involved in air cargo security a discussion of how requirements are established for any one portion of the aviation security community cannot be made in the absence of understanding how the other members are regulated. The TSA is a sub-organization of the Department of Homeland Security. It was

Back to Table of Contents

created by the significant legislation following the 9/11 attacks. This legislation had the most visible effect of assigning the responsibility for the conduct of pre-board passenger screening and checked baggage screening to the TSA. This legislation was called the Aviation and Transportation Security Act of 2001 ("the ATSA").

The legislation formed the basis of the authority or actions taken by the various Federal agencies which are managed based upon what organization or activities they pertain to. Laws granting authority to the TSA are contained in Title 49 of the U.S. Code. This title is concerned with laws on transportation. Reference to the original legislation that gave rise to requirements often sheds light on the intent and extent of the requirements themselves. It is sometimes the case that authorizing legislation is overlooked by closely examining regulatory requirements.

Since the TSA is a branch of the U.S. Federal Government it derives its power from authority-granting legislation such as the ATSA. It is the job of the TSA and other administrations within the DHS and the Federal government to execute or perform the responsibilities assigned in legislation. It does so by regulation; through proposing and establishing Federal regulations. These regulations are organized or codified according to what segment of the public they pertain to. In the case of regulations dealing with the airport, they are contained in Title 49 of the Code of Federal Regulations entitled "transportation;" specifically in the 1500 series of regulations:

- 1520: Sensitive Security Information
- 1540: Individuals and other entities not regulated in the other major sections
- 1542: Airports
- 1544: Passenger Air Carriers and Large Air Cargo Carriers
- 1546: Foreign Passenger Carriers and Large Foreign Cargo Carriers
- 1548: Indirect Air Carriers

The above Federal regulations contain wording similar to "...and the entity (airport, air carrier, IAC) will abide by the conditions of their approved security program." Security programs are an essential element of the regulatory structure that establishes requirements for air cargo security and all other regulated aviation entities. Airports are required to have approved Airport Security Programs. Airlines are required to have approved aircraft operator security programs. Indirect Air Carriers are required to have security programs, as are foreign air carriers. It is within these approved security programs that the specific security measures and requirements are spelled out. These security programs are Sensitive Security Information by definition. The reason for this is that if an adversary knows the details of security measures it becomes substantially easier to circumvent or subvert that measure. Since adherence to security programs is required by the publicly published regulation, the entire contents of the security programs are made into regulatory requirements by reference, once approved by TSA.

There is another means by which the TSA establishes requirements upon the aviation security and air cargo community. It is the Security Directive. The conditions upon which a Security Directive is issued are identified in the regulations. These state that when the TSA determines that additional security measures are necessary to respond to a threat assessment or to a specific threat against civil aviation, a Security Directive is issued. Compliance with Security Directives is mandatory as it is with regulations or with an approved security program.

5. Definition and Terms

There are two sets of definitions which have application to air cargo security. The first set is contained in the U.S. Code of Federal Regulations Titles 14 and 49. A clear understanding of these regulations is necessary to understand an airport's regulatory compliance responsibilities. The second set of definitions is provided by ICAO Annex 17. These are the definitions that are used so that terms are commonly understood across national boundaries. The United States is a signatory to ICAO and therefore must, at a minimum, adhere to ICAO requirements unless it files a formal "exception." U.S. requirements often exceed those of ICAO.

Definitions relating to air cargo security contained in Title 49 U.S. Code of Federal Regulations

Back to Table of Contents

Air Operations Area (AOA)

The portion of an airport, specified in the Airport Security Program (ASP), which includes aircraft movement areas, aircraft parking areas, loading ramps, safety areas and any adjacent areas (such as General Aviation) that are not separated by adequate security measures. It does not include the Secured Area. (Note: this definition differs from a prior FAA definition of the AOA and should not be confused.)

Airport Security Program

The security program that is approved by the TSA for an airport regulated under 49 CFR 1542.

Airport Tenant

Any person that has an agreement with the airport operator to conduct business at the airport but does not include aircraft operators regulated under 1544 or 1546.

Airport Tenant Security Program

An agreement between the airport and an airport tenant that specifies which security measures the tenant will perform. It must be approved by the TSA.

Cargo

Items tendered for air transportation accounted for on an air waybill. This includes commercial courier consignments whether accounted for on an air waybill. Further definition is provided in the aircraft operator standard security program.

Exclusive Area Agreement

An agreement between the airport and an aircraft operator regulated under Part 1544 or 1546, whereby the aircraft operator assumes security responsibilities. It becomes a portion of the ASP and must be approved by the TSA.

Indirect Air Carrier

Any person or entity in the United States that undertakes to engage indirectly in air transportation of property and uses for all or any part of such transportation the services of an air carrier. This does not include any FAA certificated air carrier, the USPS or representatives acting on behalf of the USPS.

Screening function

The inspection of individuals or property for weapons, explosives and incendiaries.

Secured Area

The portion of an airport, specified in the ASP, where certain security measures identified in Part 1542 are carried out. This includes areas where aircraft operators regulated under 1544 and 1546 enplane and deplane passengers, sort and load baggage and any adjacent areas that are not separated by adequate security measures.

Security Identification Display Area (SIDA)

The portion of the airport, specified in the ASP, where certain security measures are carried out. This includes the Secured Area and may include other areas of the airport. Any part of the AOA which is used to load and unload cargo from an aircraft of a 1544 or 1546 air carrier or where cargo is present after acceptance by a 1544 or 1546 air carrier must also be classified as a SIDA.

Sterile Area

The portion of the airport, defined in the ASP, provides passengers access to boarding aircraft and to which access is generally controlled by the screening of passengers and property.

Unescorted Access to Cargo

The authority granted by the aircraft operator or IAC to individuals to have access to air cargo without an escort.

Back to Table of Contents

Security Threat Assessment

A term undefined in 49 CFR 1540 -1550 but subject to frequent usage. This term was introduced through the Air Cargo Final Rule but not specifically defined. It is a background investigation performed by the TSA for those individuals requesting unescorted access to cargo.

ICAO Definitions regarding air cargo security, Annex 17 Chapter 1

Airside

The aircraft movement area of an airport, adjacent terrain and buildings or portions thereof, access to which is controlled.

Cargo

Any property carried on an aircraft other than mail, stores and accompanied or mishandled baggage.

Regulated Agent

An agent, freight forwarder or any other entity which conducts business with an operator and provides security controls that are accepted or required by the appropriate authority in respect to cargo or mail.

Screening

The application of technical or other means which are intended to identify and/or detect weapons, explosives, or other dangerous devices, articles or substances which may be used to commit an act of unlawful interference.

Security

A combination of measures and human and material resources intended to safeguard civil aviation against acts of unlawful interference.

Security Control

A means by which the introduction of weapons, explosives or other dangerous devices, articles or substances which may be used to commit an act of unlawful interference can be prevented.

Security Restricted Area

Those areas of the airside of an airport which are identified as priority risk areas where in addition to access control, other security controls are applied. Such areas will normally include all commercial aviation passenger departure areas between the screening checkpoint and the aircraft, the ramp, baggage make up areas, including those where aircraft are being brought into service and screened baggage and cargo are present, cargo sheds, mail centers, airside catering and aircraft cleaning premises.

6. ICAO Standards and Standards and Recommended Practices

The International Civil Aviation Organization (ICAO) is a United Nations organization which is devoted to civil aviation. It establishes practices for all areas of international aviation with the aim of standardization and seamless operations between the air space of sovereign states. Just as the U.S. Code of Federal Regulations is organized by subject matter into “Titles,” the ICAO requirements are divided into Annexes according to subject. Annex 17 is devoted to aviation security. Many ICAO requirements called standards bear upon the civil aviation authorities of the member states and indirectly apply to international airports. It is helpful to review these to see what is required by ICAO at international airports.

For clarification, while a Standard requires compliance, a Recommended Practice is suggested but not required. There are five Standards and one Recommended Practice that are dedicated to air cargo security. (ICAO Annex 17, Amendment 11) Standard 4.6.1: Each Contracting State shall ensure that security controls are applied to cargo and mail, prior to their being loaded into an aircraft engaged in passenger commercial air transport operations. Standard 4.6.2: Each Contracting State shall ensure that cargo and mail to be carried on a passenger commercial aircraft is protected from unauthorized interference from the point security controls are applied until departure of the aircraft.Standard 4.6.3: Each Contracting State shall establish a process for approval of regulated agents, if such agents are involved in implementing security

Back to Table of Contents

controls. Standard 4.6.4: Each Contracting State shall ensure that operators do not accept cargo or mail for carriage in an aircraft engaged in passenger commercial air transport operations unless the application of security controls is confirmed and accounted for by a regulated agent, or such consignments are subjected to appropriate security controls. Standard 4.6.5: Each Contracting State shall ensure that catering, stores and supplies intended for carriage on passenger commercial flights are subjected to appropriate security controls and thereafter protected until loaded onto the aircraft. Recommendation: Each Contracting State should ensure that security controls to be applied to cargo and mail for transportation on all cargo aircraft are determined based on a security risk assessment carried out by the relevant national authorities.

7. Specific Regulatory Requirements of the major parties; Air Cargo Security at Airports

Title 49 Code of Federal Regulations, Part 1542 is primarily devoted to Airport Security. The TSA is responsible for issuing these regulations and ensuring compliance. The agency generally verifies compliance by conducting audits and inspections. Not all airports fall under the jurisdiction of Part 1542. In general, an airport must comply with Part 1542 if it has scheduled passenger service with aircraft of 61 seats or more. It also applies if there is public charter service with 61 seats or more. Similarly, if there is scheduled air service of 60 or fewer seats that deplanes into the sterile area of another airport, the airport must comply. The regulations also require that a Part 1542 airport must have an Airport Security Program (ASP) that is approved by the TSA. The approval is through the Federal Security Director.

- Part 1542.111 allows an airport to delegate responsibility to an air carrier or foreign air carrier by means of a specific kind of contract called an Exclusive Area Agreement (EAA). In general, EAA's can only be established with air carriers or foreign air carriers. An airport may delegate security responsibilities to non-air carriers operating at the airport by means of an Airport Tenant Security Program.
- Subpart C of 1542 is entitled "Operations." It is a crucial section and full of cross references to other regulations. In accordance with the Subpart, airports with scheduled service by a U.S. or foreign air carrier with an aircraft of 61 seats or greater must establish a Secured Area of the airport in which the highest level of security measures are performed to protect passengers, aircraft and air cargo. Furthermore, Section 1542.205 requires that the Secured Area must include an area where security identification badges are continuously displayed, and specific security measures are performed. These areas are called Security Identification Display Areas, or SIDA's. Areas of the airport which are not included in the Secured Area but are within the airport perimeter are identified as Air Operations Areas (AOA).
- Sections 1542.201 and 1542.207 combine to provide the operational requirements for an airport's access control system. These sections stipulate that airports must have an access control system which only grants access to authorized individuals, and that the airport must prevent and detect the entry, presence and movement of unauthorized persons and vehicles in the Secured Area.
- Before an individual can be granted unescorted access to the Secured Area of an airport, that individual must pass a background investigation: the Criminal History Records Check (CHRC) and a Security Threat Assessment (STA). Section 1542.209 enumerates the procedures and specific standards for the CHRC. This is a highly detailed section that closely reflects the legislation that resulted in this regulatory section to be adopted.
- Once an airport has determined which individuals will be granted unescorted access, there must be a method to identify those individuals. Section 1542.211 contains the requirements for these Identification Systems or ID badges. A logical requirement that is implied is that employees who have been granted access and have been given an ID badge must know what to do if they observe an unauthorized person on the ramp. These procedures are set out in Section 1542.213 entitled Training. Airports often refer to this as SIDA training. Employees are not granted the ID badge until they have successfully completed the SIDA training.
- The final operational requirement of the airport is to supply law enforcement officers to support the security requirements of the airport. These requirements are contained in Sections 1542.217, 1542.219 and 1542.221. Subpart D of 1542 contains the final requirements, which pertain to crisis management. This subpart requires that each airport must have and exercise a contingency plan, and establish procedures for managing security incidents. It also requires that airports must comply with Security Directives and post Public Advisories when directed to.

Regulations, security programs, and security directives provide minimum requirements that must be

Back to Table of Contents

implemented by regulated parties. The following best practices are recommended for use by regulated and non-regulated parties that deal with cargo.

8. Non-Regulatory Security Practices for Air Cargo

8.1 Employee Issues:

- Each separate facility, and in many cases, each tenant, should appoint a security officer who will be responsible for interacting with the managing entity of the building and/or appropriate airport staff on all security issues.
- Airport and tenant employees should be trained to question the presence of unidentified persons in the cargo areas.
- Active cargo areas and any areas providing potential access to the aeronautical operating area should restrict entry to authorized employees only.
- Tenants and handling companies should establish policy guidelines and physical checks to ensure that the whereabouts of all employees on each shift is known.
- Tenants and handling companies should have clearly designated individuals responsible for signing freight in and out.
- Tenants should establish controls to record movements in and out of the cargo areas.

8.2 Non-Employee Issues:

These guidelines were designed to address access issues for individuals employed by businesses external to the airport and its cargo tenants.

- Every tenant should ensure that persons not authorized unescorted access to cargo areas are kept away from the cargo areas unless escorted
- Tenant and airport employees should ensure that there is no parallel parking of trucks in front of cargo bays
- Tenants should limit the access of Customs Broker runners to the facility and supervise their movements
- No private vehicles should be allowed to park near loading areas
- Tenants should ensure that no pickup is made without a valid release order. In the event there are any concerns, clarify any doubts with the consignee

8.3 Physical/Equipment Issues:

These guidelines were created to focus attention on physical design and equipment issues as they relate to security monitoring devices and planning elements of the building and site.

- The tenant should create a high security, limited access vault area for high-value goods
- When possible, tenants or the landlord should install a silent alarm system, connecting cargo areas with the airport security desk or a 24-hour alarm monitoring organization if the airport security desk is not staffed on a 24-hour basis
- Loaded mobile equipment should be always kept secure
- Key-operated positive locking devices should be installed in all mobile equipment
- All cargo containers whether empty or loaded should be secured and access limited
- The contents of cargo tug trains should be covered to prevent open viewing both to and from the aircraft
- Forklifts and other related equipment that could be used to force access to the cargo areas should be secured and access controlled

Back to Table of Contents

- The gates and doors of all trucks containing cargo should be locked when not in the process of loading or unloading
- Physical planning configurations should eliminate employee vehicle parking immediately next to the cargo building
- Segregate trucking from both employee parking areas and any parking facilities reserved for airlines.

9. IMPLICATIONS OF SECURITY FOR FACILITIES AND INFRASTRUCTURE

9.1 Airside/Landside Demarcation

An air cargo operation is intermodal. While traditional security applications have tended to focus heavily on the airside, there are three aspects of an air cargo leasehold that must be considered when addressing security issues.

- The aeronautical component to include taxiways and ramp, including setbacks
- The building as it pertains to the dimensions, configuration and operating characteristics of the internal space allocated to warehouse, office and other related uses, and. the concentration of truck and airside doors
- The landside component includes building frontage, queuing capacity, parking for customers and employees and roadway access.

Aeronautical Component

The non-movement area includes aircraft parking that is usually adjacent to the cargo building, as well as the taxiways and taxi lanes that provide access, and any restricted service roads that enable belly cargo tugs to move on non-public roads to and from the passenger terminals. Direct aeronautical access to aircraft apron is not necessary for every tenant. Passenger-only carriers and handling companies that deal with belly cargo need only be connected to the movement area via a restricted service road. However, most carriers flying freighters, or handling companies dealing with freighters, need to have ramp access, and most appropriately, ramp directly adjacent to the building to minimize operating costs.

Building Component

The dimensions of a building directly impact the number of access points on both the airside and landside, and the resultant complexity of access control. Buildings must be designed with throughput, operating efficiencies and leasing costs in mind. In leasing cargo facilities, rental rates are typically based on the leasehold square footage and the footprint of the building, while the tenant's operating efficiencies, in many cases, may be substantially enhanced by the height of the facility. The design and installation of security systems will add costs and may impact throughput capabilities. Other critical elements in building design are the number, dimensions, and spacing of cargo doors on the aeronautical and landsides, the use of floor versus mezzanine office, and storage for equipment.

Landside Component

Typically, the landside element of an air cargo facility must have sufficient space for truck turning and queuing, acceptable proximate roadway geometry and acceptable overall access to the leasehold. In many airports, older cargo facilities were not designed to accommodate the larger trucks that are typically used today for long-haul trucking. This is true of the areas surrounding the cargo buildings, as well as the access roads to the cargo areas in general. Ensuing problems usually result in diminished traffic flows, random off-site truck parking and a negative impact on air quality.

Another critical element of landside planning is the automobile parking requirements for the facility. Typically, a freight operation does not require extensive parking; however, on an airport the needs can vary. Employees and customers must both have proximate parking that is physically separated from the trucking operations. In instances where automobile parking is limited, employee parking is usually shifted to a remote area, shuttles are set up, and operating costs are increased.

Back to Table of Contents

9.2 Site Fencing/Gate Security

The most obvious manifestation of airport security is fencing. In cargo areas it serves the dual purpose of keeping intruders out and freight in. Typical perimeter fencing around a site is eight feet, heavy gauge chain link. It is likely that future site design will require separation of automobile parking areas from trucking with fencing and security gates. It is also recommended that access points to the AOA from the cargo facilities be reduced and manned checkpoints be established. Access points to the cargo facilities from the roadway should be minimized and manned gates created. The result may be additional staffing requirements and the potential for further delays.

9.3 Single-Tenant Facilities

Single tenant facilities, whether carrier or handling company controlled, are easier to secure than multi-tenant buildings. There are no concerns over the integration of individual tenant security systems and technology, fewer access points, direct accountability, and lower installation costs. The building system should be linked to airport security and local law enforcement as necessary and appropriate. The interior design should allow for the control of visitors in a single area without impacting efficiency or effectiveness. As compared to a multi-tenant facility it has the benefits of more visible and known staffing and an interior that is more open to observation of the cargo areas. At most airports, however, single tenant buildings are not the predominant facility.

9.4 Multi-Tenant Facilities

Multi-tenant facilities represent challenges from several perspectives. Unless the facility has been developed or is managed by a third party, the most problematic issue is accountability for day-to-day security in common building areas and within the vehicle areas. Historically, airports have had difficulty with tenants failing to perform even routine maintenance or policing of such areas. Insurance issues associated with security accountability may create a major obstacle. These facilities typically have multiple access points to serve the tenants: this will add impediments and additional costs to access control. A more complex issue is the introduction of security technology into the building. With a single tenant with uniform operating equipment and procedures the design and implementation of security technology to include such items as physical characteristic verification devices, closed-circuit television (CCTV), screening devices, etc., is less expensive and easier to maintain. In new facility development, the building design should incorporate security systems and technology enabling amortization of investment over a longer period and minimizing the impacts on tenants. The addition of individual tenant systems after leasing typically will be more costly for the tenants and more difficult to monitor and maintain.

9.5 Landside Access:

Roadways

In an ideal environment, trucking activity, beginning with entry onto the airport grounds, should be separated from automotive/passenger traffic. A system of readers and transponders will allow a central control to track the vehicle from the airport entry as it moves to a central screening area, and eventually, the cargo facility. Electronically cross-referencing the driver with the truck should also be included at the screening facility. Roadways should be wide enough and appropriate to allow for easy unrestricted movement. The problem is that many airports do not have roadway systems that currently provide for an optimum vehicle separation, nor do they have the physical capacity to make modifications. In other instances, the capacity to develop a truck screening facility with appropriate queuing areas may also be lacking. For those airports with the space to accommodate potential changes to trucking movements, the cost of creating new screening facilities and potentially miles of road, may be prohibitive.

Parking Lot Access

To mitigate theft, a well-designed cargo facility requires that automobiles and trucks be segregated regarding access to the complex, as well as vehicle parking. This separation should be physically engaged with visitor and employee lots positioned away from the building and secured with a single manned pedestrian access gate. All employees and visitors should be checked and be subject to local security and administrative processes. No employee vehicle parking should be adjacent to the building. Parking for key management staff, or for persons with disabilities, should be provided as appropriate, however even this parking should be designed away from cargo bay doors. Truck and driver identification should be verified

Back to Table of Contents

at the entrance to the cargo facility. After admittance, trucks should queue in an area away from, but easily accessible to the cargo bays. All drivers whose trucks are not loading should be either in their vehicles, in a rest area if one is available or in a secure area in the facility handling their paperwork.

Building Access

Facility access must be tightly controlled. Cargo facilities with their extensive truck bays offer several access opportunities that must be controlled by observation and physical barriers. These can be as basic as keeping the bay doors closed until a truck is in the dock, or monitoring and enforcement of the "yellow line." The "yellow line" can be an actual line that is painted on the floor of cargo facilities parallel to the front of the building. Usually, it is 20 feet from the bay doors and defines the point beyond which unauthorized personnel may not pass. This concept is recognized by the trucking industry whose drivers need to be inside the cargo building to load and unload vehicles.

Part of the difficulty in securing a cargo facility is the diversity of the population who need to access it and the differences in the levels of access that each require. Office space should be physically separated and secured from the warehouse, however provide easy access for customers at ground level. Access to mezzanine offices should not allow non-employees to enter warehouse space.

9.6 Facility Design Considerations to Accommodate Air Cargo Screening

When approaching the subject of facility design for air cargo screening it is important to take a step back and reflect upon a couple of basic differences between passengers and cargo regarding screening. Aircraft passengers generally range from about 30-40 pounds for children to an upper range of about 300- 400 pounds for the largest adults. They may bring to the airport both checkable baggage and carry-on. In either case, the baggage must be carried by individuals. This puts a significant limitation on both size and weight. This is not the case with air cargo. A single piece of air cargo may range from one or two ounces to several tons. This extreme diversity of size and weight is replicated by diversity in density and a broader diversity in the items themselves.

The point is that the challenge of screening cargo effectively is daunting. The numerous elements of diversity require that numerous methods are employed to screen cargo. The screening approach must be adequate to handle the size, weight, density and material that is being examined. In turn, the approach (and related technology) can have significant and different implications regarding cargo facility design. Some cargo is still subject to physical inspection and hand search. The space/facility requirements for this type of screening are minimal. Cargo that is screened using the Electronic Trace Detection (ETD) technology has a greater but similarly minor requirement for space. ETD's typically have a 3-4 sq. ft. footprint and weigh less than 100 pounds. At the opposite end of the technology spectrum are the automated Explosive Detection Systems such as the CTX 9000 which weigh several tons, have the footprint the size of an automobile, require air conditioning and heating and often require handling equipment to get the cargo into and out of the system.

Space requirements for cargo screening operations can reflect the type of technology being employed and the type of cargo being screened. It is envisioned that the use of consolidated cargo screening facilities will continue to increase. Around the globe a range of technologies are being employed to screen cargo. However, not all technologies are necessarily approved methods in all countries or by the TSA, but these technologies provide the widest possible view of what is available. Representatives of the appropriate authority (TSA, CAA, etc.) should be consulted prior to serious consideration of any technology. As previously stated, the airport has no direct role in the screening of cargo.

9.7 Recommended Security Guidelines for Airport Planning, Design and Construction

The TSA released the above titled document in May 2011. The Aviation Security Advisory Committee Working Group which was composed of experts from industry and government contributed to this comprehensive reference for airport security construction. Section D, Part 3 directly addresses air cargo facilities and screening. Much of what is contained under the other headings of this volume can be applied to air cargo security. It is recommended that airports maintain a copy for frequent references. An electronic version of this document which has links to related documents can be obtained from ACI-NA.

Back to Table of Contents

9.8 Other Important Considerations and a Look Ahead

Airport Capacity

Airports measure capacity in different ways

- The most obvious is airspace; the ability of the region to sustain certain levels of air traffic. This is not typically an issue for cargo since it can and frequently does move at times other than passenger peaks.
- A second aspect of capacity is the aeronautical infrastructure. This is the ability of the runways, taxiways and aprons to accommodate the safe movement and parking of aircraft. If there is a shift to freighters, many airports may be unable to meet the resulting demand for parking positions.
- The third aspect of capacity is terminal capacity. This pertains to passengers and would not typically be an issue for cargo. Instances may occur where carriers who operate both passenger and freighter operations opt to change their route structure to fit with constraints arising out of cargo constraints thereby impacting terminal capacity.
- The fourth aspect of capacity is cargo facility capacity. Any major policy changes impacting how cargo is moved (belly versus freighter) could create serious mismatches in the compatibility of facility design and location with recommended revised operating guidelines. The cost implications could be substantial for many airports,
- The last aspect is landside access. All the major gateways and most large airports are geographically constrained. Requirements to create new roadway access points or screening facilities with large queuing requirements will cause enormous problems for these landlocked airports.

At airports where there is a lack of capacity for expansion, the airport may need to explore the availability of off-airport property that can be utilized for cargo screening and or handling. This may require the formation of public/private partnerships to include the use of third-party developers and the use of private funds.

9.9 Inbound Freight

Many aspects of air cargo shipments do not impact airports directly but are critical to improving air cargo security. They involve expedited clearance to minimize the length of time inbound international freight remains in the warehouse facility. This will involve a broader and more effective application of electronic clearance mechanisms. By inference this will involve increased compatibility between the requirements of the relevant government inspection agencies at the origin and destination of a shipment. This compatibility must be supplemented by enhanced communications that will facilitate data transmission within and between countries of origin. If goods can be cleared electronically, particularly shipments such as perishables, live animals, personal effects, and low-value goods, then targeted dwell times can and should be reduced to less than four hours. The system for clearing goods must be simplified as well as standardized. Entries into the system must however remain sufficiently clear to enable Customs and other facilitation organizations or other governmental entities, to identify information relevant to expedited pre-clearance. Partial shipments, when possible, should also be released as soon as possible rather than be held until the entire shipment is ready for release.

9.10 All-Cargo Airports

The major forecasting agencies are calling for the world's air cargo volumes to double over the next 20 years. Given the constraints facing established airports, it may become necessary to consider the redevelopment of existing underutilized airports, or the creation of new all-cargo airports to meet the industry's needs. The costs for a new facility and the potential for economic disruption to other regions are substantial. Beyond that, a new airport (or airports) would create the need to totally reexamine how goods are moving throughout the country. A hub and spoke system of all-cargo airports strategically located throughout the country and linked to a massive trucking system could be an ideal solution to the cargo security issue. The reality is that an all-cargo airport may in isolated instances work and bring benefit to the region in which it is located. However, the creation of a network would have major implications for existing regional economies, create substantial local job losses for existing airports and foster the loss of additional jobs through the relocation of manufacturers. The financial impacts on carriers and airports could be substantial and the higher costs of goods movement to sustain the new infrastructure would be challenging.

Back to Table of Contents

9.11 Implications of Cargo Security Costs:

Airports essentially have very limited resources to dedicate to cargo security. With most airports facing revenue challenges, and increased costs associated with the implementation of passenger security enhancements and related operational modifications, limited funding is typically available for cargo. This is not a new situation. Given funding challenges, many airports (and carriers) historically have placed their primary emphasis on the passenger segment that has been their principal source of revenue.

Air freight typically costs about eight times as much as trucking. Nevertheless, success in the cargo industry is predicated upon high volumes and small margins. Raising the cost of shipping by air will push additional domestic freight and possibly some international freight to other modes. The resultant loss of business could create a cycle of escalating costs and freight diversion. It is difficult to envision the diverse firms in the industry having the capacity to absorb the costs of infrastructure improvements that could evolve out of new security requirements. Airports have no unique mechanisms to raise funds that could be dedicated to security infrastructure modifications.

10. CERTIFIED CARGO SCREENING FACILITIY (CCSF)

Because of the “belly” cargo screening requirement and the intent of the TSA to push cargo screening back down the logistics chain, smaller cargo support functions have sought out Certified Cargo Screening Facilities (CCSF) for operating assistance and financial relief. There are several such operations located off airport in forwarder and trucking facilities. As security protocols mature, there is increased interest in having a CCSF (or several) located on the airport. This would reduce operating costs substantially if the facility could be located such that it would have airside access via restricted service road. This would eliminate the need to reload inspected cargo onto a truck for movement to the carrier. A CCSF would be an ideal element in an on-airport cargo village. A typical such facility allowing for truck circulation could require approximately 100,000 square feet.

11. CARGO SCREENING TECHNOLOGIES

Cargo screening technologies are as diverse as the items of cargo carried aboard aircraft. This presents a challenge for the airport manager who is planning for cargo screening facilities. Although it is the aircraft operator that retains the responsibility for cargo screening, it is the government authority (TSA, CAA, etc.) who determines which technologies and which equipment will be authorized to be used for cargo screening. So, while screening equipment manufacturers may advertise a particular piece of equipment as a “cargo screening unit” it is essential to know whether or not that particular piece of equipment is authorized for use in a given country; while a piece of equipment is acceptable for the screening of cargo in one country it may not be acceptable in a second or third country.

While the FAA, and now the TSA, established a certification standard for Explosive Detection Systems (EDS) for all passenger checked baggage and subsequently certified specific equipment, the extreme diversity of air cargo works against any such single “certified cargo screening system.” It may become the case that certain systems are certified to screen only certain types of cargo while other’s systems are certified to screen entirely different types of cargo.

The simplest form of cargo screening device is the human being. A trained individual can effectively screen certain types of cargo. Following this, explosive detection dogs have been used to screen cargo for explosives. The caveat, a given cargo screening method may only be applied if it is approved by the appropriate government authority. The recognition of the need for harmonization of requirements between countries bodes well for more acceptance of “equivalent” cargo screening.

Some of the screening technologies that are employed at the passenger screening checkpoints have also been employed to screen cargo. They are the X-ray, the Advanced Technology (AT) X-ray and the Explosive Trace Detector (ETD). This equipment, and their manufacture’s, have evolved over the last 20 years. Their size, weight and power requirements are relatively familiar. The requirements and dimensions of ETD technology can be obtained by referring to the website of GE Security or Smiths Detection. This is an evolving technology that is constantly changing. Any discussion of specific devices or technology will likely be out of date before the ink dries. For that reason, the following is a general discussion that should not be taken as authoritative:

High Energy X-ray Cargo Screening Devices

Several companies produce high energy X-ray imaging systems that are designed for the screening of

Back to Table of Contents

cargo.

TSA Certified Explosive Detection Systems (EDS)

There are many devices that can detect explosives and several that are advertised as explosive detection systems. The FAA developed detection performance standards for the certification of Explosive Detection Systems. These performance standards identified the types, configurations and amounts of explosive that must be detected. The first system that met these standards was certified in November 1994. Since that time the TSA has continued these certification standards and currently there are multiple systems that are TSA certified Explosive Detection Systems.

X-ray Diffraction Technology

These are designed to be used downstream of an EDS system for the purpose of providing more definitive screening of items that have been identified as suspect items. These systems are not advertised as stand-alone systems but rather an additional feature to be added to an EDS system

Gamma Ray Technology

Gamma Ray Technology is designed for screening cargo carried in trucks. Gamma Rays are much more powerful and have greater penetrating power than X-rays so they can see through much denser material than X-ray technology. For this reason, they require greater shielding and attendant safety measures. The Gamma Ray devices are high-power imagers. They are not specifically designed to detect explosives as an EDS or ETD. Their ideal use is to scan a truckload of cargo to see if the material on the manifest is what appears on the image.

Pulsed Fast Neutron Technology

Pulsed Fast Neutron technology is being tested for application to cargo screening. It is a system whereby a pulsed beam of high-energy neutrons is scanned up and down in a raster (grid) pattern while the object under inspection is conveyed through the beam; characteristic gamma rays emitted by materials in the object are detected to analyze and image these materials with the help of time-of-flight measurements.

Appendix - Air Cargo Field Guide for Airport Operators

Four Steps to a Common Sense Understanding of Air Cargo Security at Your Airport

The following steps are designed to provide a real-life understanding of the basics of air cargo security operations and responsibilities of the airport. There are many other parties involved, each with their own set of security responsibilities and regulations. But for an airport manager reporting to a new airport, or a manager assuming air cargo responsibilities, these are four questions which if followed will result in a basic understanding of the airport's air cargo security responsibilities.

1. **Where is (or are) the air cargo operations on the airport?** Find the cargo operations on the airport layout plan map. How is this area depicted in the Airport Security Program (ASP)? What does the ASP state about these areas? What does the ASP say our responsibility is for this area? The answer will likely be that the airport is responsible for the perimeter fence surrounding the cargo area and that the airport has responsibility for access control measures at and around the cargo areas to include such things as doors, pedestrian gates and vehicle gates. Finally, a further question may be: "Are there any Security Directives or Emergency Amendments which modify what our ASP requires us to do?" Answering the above question will establish a firm foothold of understanding regarding your responsibilities for air cargo security.

2. **How does cargo get to the aircraft?** In addition to cargo being introduced into the system through the on-airport cargo facility, there are often secondary ways that cargo gets on aircraft. Establishing partnerships and relationships with the cargo handlers, carriers and ground handlers allows the identification of all the different means by which cargo gets on their aircraft. As an example, a courier for a medical lab could bring blood samples to an air carrier ticket counter each night for shipment to another blood lab. Another example might be a cargo airline that has a consolidation center located off-airport that brings in a truckload of cargo through a vehicle gate and loads the airplane from the truck. After identifying all these secondary air cargo venues, you may proceed upon the same line of questioning as before to come to a different conclusion.

3. **What is the airport's responsibility for badging the air cargo employees?** What does the ASP say about the airport's responsibility for issuing airport access badges to individuals involved in air cargo?

Back to Table of Contents

Make sure you read the ASP section yourself. The ASP does not actually say what the individuals who deal with it on a day-to-day basis. The issue of granting airport access badges requires that the airport perform a background investigation for most areas of the airport. Identify which areas of the airport require a background investigation.

4. **What is the airport's responsibility when something goes wrong?** What happens if cargo is suspected of containing a bomb or a stowaway? What happens if cargo catches on fire on or off the aircraft? What happens if an intruder is found in the cargo area? These questions focus on the fact that the airport has a great deal of responsibility for emergency response both for security and police issues as well as for rescue and firefighting.

5. Cargo is diverse and the issues that could arise can be unanticipated and challenging. The key to successful management of a cargo function is maintaining awareness of industry best practices and the implications for your airport.

Back to Table of Contents

Chapter 10

Alternative Land Use

Back to Table of Contents

1. Purpose and Goal

In response to growing financial pressures on both aviation authorities and their constituents, airports are continually studying new ways of asset management including the use of airport property for expanded and non- traditional business uses. This chapter offers ideas that will help individual airports recognize and address the challenges associated with such development. The intention isn't to present specific answers to the questions airports ask as every airport development scenario is different and should be predicated upon established and prioritized business goals.

2. Definition

Countless articles have been written about the concept of airports as an impetus for urban development. Airports have long been regarded as engines for economic development. They generate jobs on and off the airport. In larger markets this number can be in the thousands, while a large hub airport can have a work force of 25,000 or more. As the industry has matured, a wide range of ancillary and support businesses and services has grown to accommodate the needs of aviation tenants and customers. However, it is important to remember that investment in airport development is predicated upon expressed demand and a wide range of enablers. Sound airport planning is based on this deliberate and rational foundation.

Usually regions will locate airports, at sites that are removed from, but readily accessible to central business districts and population centers. Safety, existing infrastructure, operating concerns and environmental matters all differentiate the airport from alternative urban land use. It is in many cases a 24-hour per day operation and its unique atmosphere, while dynamic and exhilarating, does not lend itself to a wide range of alternative uses. Successful airport development includes extensive physical and environmental due diligence, regional transportation planning, a complex array of business forecasts and operational analyses, legislative empowerment, national, regional and municipal review, along with smart financing. All of this must take place in a market that will enable the facility and services to be financially self-sustaining, while assuring compatibility with neighboring communities. Geographic locations where such a combination of factors exist are decidedly limited.

Because airports are designed to move airplanes, their infrastructure will sometimes create areas of land that do not lend themselves to traditional uses. Many airports are exploring alternative uses for some of these parcels of land that can generate additional revenue and higher levels of service for their constituents. Such uses are constrained by safety, security, planning, and operating issues that are federally controlled to protect the long-term capacity of the nation's airports and aviation system. In addition, most airports are constrained by geography, roadways and surrounding development. In a few instances, where recently constructed airports have substantial amounts of property, there is limited social, political or economic will to tackle the complex issues that would foster broader use. Perhaps most important, there may not be a mechanism that would facilitate financial investment in the absence of demand, particularly when substantial proximate off airport properties are available for less money and unencumbered by the vast array of regulatory issues with which U.S. airports must deal.

The growth of the aviation industry in Asia has stimulated the development of airports and airport facilities on a scale that hasn't been seen in mature markets. Newer facilities are introducing many of the planning principles and design features that technological advances have made possible in the industry. However, the same planning, safety, environmental and operating mandates still largely pertain. The key exceptions are instances where surrounding urban development does not mitigate against it (e.g. where multi-modal access via rail, motor coach and ferry service). This changes certain marketing and demand assumptions for airports and warrants the introduction of a different array of services and amenities. The concept of "the" airport as a stimulus for urban development, as it has become often articulated, is not particularly innovative, nor is it without precedent or insurmountable hurdles, even in most of Asia.

Many of the concepts we have heard about become a consistent and reliable model of the economic development and some artificially inflate it to a level that few airports can ever hope to achieve. In the financially challenged world of aviation and airports, the fiscally prudent allocation of funds is important. Unrealistic expectations can take politicians and communities down a road from which it is difficult to return. The journey to the airport city or "Aerotropolis", is a slippery slope fraught with complex planning, operating and regulatory issues. Occasionally we all like to think of things that could be. In the real world, regardless of the opportunity, an airport's location relative to supply chains and the consumer marketplace drives the critical issues of demand and financing and dictates the feasibility of development. There are far too many examples of visionary airport projects standing empty and unfulfilled because of a rush to be first,

Back to Table of Contents

a dream of tremendous economic growth, a political mandate or a market assessment that was ignored in the haste to secure headlines. This Chapter focuses on the practical elements of development, particularly those that relate to cargo and logistics. It addresses applications to unutilized, under-utilized and potentially inappropriately utilized airport properties and explores highest and best use applications and relates these to the various business drivers that would interest an airport in such development.

However, alternative land use is not necessarily something that an airport can simply undertake. There are instances where the U.S. Federal Aviation Administration (FAA) requires that airports develop a Land Disposition/Divestiture Plan as a requirement before airports develop an Alternate Land Use plan. There may also be a complex, lengthy and possibly costly effort to obtain the release for land purchased with Federal funds. Land impacted by Federal Airport Aviation Regulation (FAR) 14 CFR Part 150, noise must be posted on the Federal Registry for public comments before Airports are authorized to develop non-aeronautical uses.

3. Purposes for pursuing development

The critical decision in pursuing development is: Why? It is essential that an airport combine business planning with physical planning in making this assessment. To the extent possible, this planning work should be integrated with regional land use planning, regional transportation planning, and economic development initiatives. For this reason, a business plan with a sound understanding of regional and industry market dynamics should form the basis for developing and prioritizing initiatives. Assuming that strategic planning of all future development is the best approach, airports must develop sufficient focus and business logic to react appropriately to an outside influence such as airline consolidation or a regional economic slump that might precipitate a need for an interim but less satisfactory alternative to utilizing a piece of property.

It is important to understand what is meant by alternative land use. It is accepted that the primary uses for airport property are passenger and cargo operations, maintenance and general aviation. These business segments receive support from a variety of different firms that typically are located off-airport because of space constraints or property costs. In an ideal environment many of these functions would elect to be located on-airport to minimize time issues, create operating synergies and/or reduce the cost of doing business. These functions become the first order of priority. Beyond these elements, there are very basic functions that serve to meet the quality-of-life requirements of the airport's employee base and those of its stakeholders. These are the next order of focus, the emphasis is on support for cargo and logistics, but several additional support functions could be included.

Typically, perimeter property away from the main terminal and ramp operations areas are the most appropriate and viable target for development. An airport's first obligation is to maintain the integrity and capacity of these areas for both the near and the long-term aviation use. However, there are instances when an airport can consider alternatives that are consistent with long-term vision and goals. This means that the airport must address why it might want to change the existing planned use of an area to something else. The following are typical considerations for investigating and pursuing alternative land use.

a. The need for strategic, as opposed to incremental land use planning.

Airports may need to revisit existing development plans (and developments) that were the result of a more-spontaneous response to a client or airport want - rather than the product of a planned approach to airport development. It may also be appropriate to create more development opportunities for a specific function (e.g. cargo and cargo support, maintenance, general aviation, etc.).

b. Optimizing the available property for aeronautical use

As airports mature and business expands (or changes), the need for aeronautical infrastructure will change as well. Redevelopment may be necessary to recapture property with aeronautical adjacency.

c. Optimizing revenue potential

Given the changing marketplace, shifts in revenue generation and new business partners, airports may look to create capacity to bring new business partners on to the airport, or develop facilities for established partners that traditionally have been off airport, but who for operating, security, or cost reasons may now prefer an on-airport location.

d. Integrating on and off airport planning

One of the critical concerns an airport faces is compatible land use. Typically, this is associated with noise

Back to Table of Contents

and other environmental issues, but from a business perspective it is equally important. Development on-airport must not be seen as a threat by local off-airport businesses, and where possible should serve as a stimulus for growth.

e. Regional economic development

Airports are considered economic engines. In the absence of suitable property around an airport, available airport property (assuming appropriate approvals) could be used to accommodate an economic initiative.

An airport must address some very basic questions including whether development of additional aeronautical use facilities is desirable and warranted. It may be that the local aviation infrastructure is seeing increased demand. However, it could be just as likely that there is no market for local growth because enhanced infrastructure and services exist and are thriving at neighboring airports. An understanding of demand in the regional market is critical to understand if development of non-aeronautical but still transportation or multi-modal related facilities would be effective for attracting growth. Such development is more likely if it is an area where manufacturing is strong or geographically well-suited for truck, train or vessel connections. The probability diminishes if the airport is a spoke in a large network carrier's hub, with little or no manufacturing and limited access to major interstate or rail lines. Real estate growth is even less likely if the airport cannot compete with the lower rents that firms usually find off airport.

It may be that development of light industrial, commercial and office would be the right fit. This could serve to offer neighborhoods a soft buffer between the harshness of parking structures or hangers but would not be appropriate if it is the last contiguous land to Airport Operating Areas (AOA) and terminal areas. Development, particularly with a private partner, can generate new revenues but limit the airport as to the eventual use of the property. Long-term leases can be expensive to buy back if the area is needed for other expansion, so it is critical to understand the market and what drives it. An airport must evaluate the tradeoffs between short-term profits and long-term growth, understanding if the new uses will still be the most appropriate and best use of property ten, fifteen or twenty years into the future.

It comes down to choices by each individual airport based on its position in the aviation system and its respective community. There are always a wide range of variables that must be examined but it is important to realize that there are no uniform answers. What is an acceptable alternative to one airport may be very problematic to another.

4. Critical Considerations in Identifying Alternative Land Uses

There are basically three categories of considerations that should be weighed in an examination of alternative land use: operational (to include security), physical (to include environmental) and outreach (to include financial). These obviously can be subset to a great many levels, but for purposes of this discussion are grouped as indicated above.

4.1 Operational and Security Considerations:

An airport must be concerned with the preservation of the appropriate land envelope for aviation's operational capacity, to include the ability to keep tenants and users safe and secure. The following are some of the primary issues to be weighed in considering new development options.

Line of Sight

- From a safety perspective, it is critical that Air Traffic Control and Airport Operations staff have direct visual access to the aeronautical infrastructure including all runways, taxiways, taxi lanes and aircraft ramps. Structures may not be erected that interfere with this line of sight.

Height of Structures

- Objects and structures can pose obstructions to air navigation. The development of multi-story facilities and communication towers should be carefully considered in relation to airport activities. Federal Aviation Regulation Part 77 provides guidance in identifying the airport airspace areas, referred to as imaginary surfaces, that should be kept free of tall structures. The imaginary surfaces are as follows:
  - Primary Surface

Back to Table of Contents

- The primary surface is longitudinally centered on a runway. When the runway has a specially prepared hard surface, the primary surface extends 200 feet beyond each end of that runway. When the runway has no specially prepared hard surface, or planned hard surface, the primary surface terminates at each end of the runway. The width of a primary surface ranges from 250 feet to 1,000 feet depending on the existing or planned approach and runway type (i.e., visual, non-precision, or precision).

- Transitional Surface
  - Transitional surfaces extend outward and upward at right angles to the runway centerline and are extended at a slope of seven feet horizontally for each foot vertically (7:1) from the sides of the primary and approach surfaces. The transitional surfaces extend to where they intercept the horizontal surface at a height of 150 feet above the runway elevation. For precision approach surfaces, which project through and beyond the limits of the conical surface, the transitional surface also extends 5,000 feet horizontally from the edge of the approach surface and at right angles to the runway centerline.
- Horizontal Surface
  - The horizontal surface is a horizontal plane located 150 feet above the established airport elevation, covering an area from the transitional surface to the conical surface. The perimeter is constructed by swinging arcs from the center of each end of the primary surface and connecting the adjacent arcs by lines tangent to those areas. The radius of each arc is 5,000 feet for all runway ends designated as utility or visual, or 10,000 feet for all other runway ends.
- Conical Surface
  - The conical surface is a surface extending upward and outward from the periphery of the horizontal surface at a slope of one foot for every 20 feet (20:1) for a horizontal distance of 4,000 feet.
- Approach Surface
  - Longitudinally centered on the extended runway centerline, the approach surface extends outward and upward from the end of the primary surface. An approach surface is applied to each end of each runway based upon the type of approach. The approach slope of a runway can be a ratio of 20:1, 34:1, or 50:1, depending on the sophistication of the approach. The length of the approach surface varies, ranging from 5,000 feet to 50,000 feet. The inner edge of the approach surface is the same width as the primary surface and expands uniformly to a width ranging from 1,250 feet to 16,000 feet depending on the type of runway and approach.

Safety Areas

- FAA AC 150/5300-13B Airport Design Standards define safety areas to allow for the safe and efficient operation of an airport. These safety areas include:
  - Runway Protection Zone
    - Runway Protection Zones (RPZ), formerly clear zones, were originally established to define land areas underneath aircraft approach paths and to prevent the creation of airport hazards or the development of incompatible land use in these areas. RPZs must be kept free of structures and any development that would create a place of public assembly. A RPZ is an area that begins at a point 200 feet beyond the end of the runway. The length of the RPZ extends 1,000, 1,700, or 2,500 feet depending on the category of runway and type of approach (visual, non-precision or precision). The inner width of a RPZ is located closest to the end of the runway. Opposite this end is the outer width, which is the wider end. The inner width of an RPZ varies from 250 feet to 1,000 feet. The outer width of an RPZ varies from 450 feet to 1,750 feet. As with the length of the RPZ, the inner and outer widths of a RPZ are dependent on the runway category and approach type.
  - Runway Safety Area
    - The Runway Safety Area (RSA) is a critical surface surrounding the runway. RSAs should be cleared and graded and free of potentially hazardous surface variations. The RSAs should be properly drained and capable of supporting snow removal, Aircraft Rescue and Fire Fighting

Back to Table of Contents

(ARFF) equipment or an aircraft (without causing damage to the aircraft). The size of the RSA is dependent upon the runway design category and approach type (visual, non-precision, or precision). Taxiways also have similar safety area requirements.

- Runway Object Free Area
  - The Runway Object Free Area (OFA) is a two-dimensional ground area surrounding the runway. FAA standards prohibit parked aircraft and objects within the OFA. The runway OFA extends beyond the runway end at lengths that vary from 240 feet to 1,000 feet, depending on the runway design category and the approach type. There are also OFAs that are linked to taxiways.

Compatible Land Uses per FAR Part 77 Surfaces and FAA Safety Areas

Legend:
C Generally compatible land use
NC Incompatible Land Use
· Not clearly compatible or incompatible, requires specific study

Criteria for Compatibility:

1. Does not exceed height standards
2. Does not attract large concentrations of people
3. Does not create a bird attractant
4. Does not cause a distracting light/glare
5. Does not cause a source of smoke
6. Does not cause an electrical interference
7. Does meet compatible DNL sound levels

Land Uses	Primary	Transitional	Horizontal	Conical Surface	Approach	Runway Protection
Residential						
Residential, other than those listed below	NC	NC	·	C	·	NC
Mobile home parks	NC	NC	·	C	·	NC
Transient lodgings	NC	NC	·	C	·	NC
Public Use						
Places of public assembly (schools, hospitals, churches, auditoriums)	NC	NC	·	C	NC	NC
Government services	NC	·	C	C	·	NC
Transportation (parking, highways, terminals)	NC	·	C	C	·	·
Commercial Use						
Offices, business and professional	NC	·	C	C	·	NC
Wholesale & retail - building materials, hardware and farm equipment	·	·	C	C	·	NC
Retail trade – general	NC	·	C	C	·	NC
Utilities	NC	·	·	·	·	·

Back to Table of Contents

Communication	NC	·	·	·	·	NC
Manufacturing & production						
Manufacturing – general	NC	·	·	·	·	NC
Agricultural (except livestock) and forestry	·	·	C	C	·	·
Livestock farming and breeding	NC	·	·	C	·	NC
Mining, fishing, resource production & extraction	NC	NC	·	·	·	NC
Recreational						
Outdoor sports arenas and spectator sports	NC	NC	·	C	NC	NC
Nature exhibits and zoos	NC	NC	·	C	NC	NC
Amusement parks, resorts and camps	NC	NC	C	C	NC	NC
Golf courses	NC	NC	C	C	NC	NC
Parks	NC	·	·	·	·	·

Source: Mead & Hunt, Satre Associates, Oregon Department of Aviation, Oregon Airport Land Use Compatibility Guidebook: 2003.

Density of Development

- One way to reduce risks of damage or injury to persons or property on the ground due to aircraft accidents is to limit the density of development at or near airports. Studies have shown that accident probabilities increase with proximity to runway ends because of the greater concentration of aircraft, flying at low altitude, over these areas. Some airports and local communities have set development density limits ranging from 25 to 100 people per acre for various parts of a runway approach corridor. Shopping centers are likely to average about 75 people per acre and restaurants: over 100 people per acre. In general, high-density residential development and places of public assembly should not be permitted in the airport's approach corridors.

Lights

- Lights that shine upward are potential hazards since they can confuse pilots in identifying airport or runway lights at night. In a similar vein, blinking lights connected with retail may create an issue.

Glare

- Reflective surfaces can produce a blinding glare that can distract pilots. This should be considered in choosing building materials and water surfaces.

Smoke

- Smoke, dust, fog and steam can reduce visibility when a pilot is looking for an airport or preparing to take off or land.

Electronic Interference

- Land uses that generate electronic transmissions can interfere with aviation navigational signals and radio communications.

Security

- Airport safety and security are preserved through a coherent closed loop of requirements and procedures, rather than a patchwork of individual efforts and programs. Anything that diminishes security in individual areas compromises airport security in general. This is true whether it is applied to passenger carriers, cargo carriers, catering or alternative land users.
- The challenge of alternate land use for non-traditional purposes, places an added planning burden on the development. Ideally, new uses will provide services and/or amenities to the existing airport community as well as the off-airport business and residential population.

Back to Table of Contents

- There are several considerations that must be weighed for the development of on-airport property for non-traditional uses. From a security perspective some are very clear. The first is what kind of fencing, if any will be required to ensure separation from the aeronautical areas. It is important to clearly define the areas to be developed. The second is access. It will be critical to understand the need for commercial and private vehicle access so that if some form of access control is required the impacts on resultant traffic queueing and parking requirements can be evaluated. More importantly, such analyses can lead to a more efficient siting of the development so that security controls are minimized or unnecessary. This may reduce development options, but in the long run eliminate additional costs associated with security. If the use will be primarily for airport tenants and users, then it is critical that access be available that will not increase the burden on airport security.
- Any new development that increases the amount of labor on-airport and the number of entries onto the Air Operations Area (AOA) increases the potential for such dangers as theft and terrorism and therefore must be undertaken with considerable attention to detail. Theft concerns are heightened by recognition that air cargo tends toward high-value, smaller items more conducive to thievery. The relatively greater terrorism threat for the cargo industry revolves around the potential misuse of aircraft as a weapon. These concerns do not form in a vacuum impervious to the larger economic development objectives of the community and security concerns of the air transportation industry in general.
- The Transportation Security Agency (TSA) has estimated there are about 1,200,000 airport and vendor employees who worked at the nation's commercial airports – with about 1,000,000 working in the secured or Security Identification Display Area (SIDA) areas. For those workers whose functions require such access, airport operators issue SIDA badges, identifying the workers and granting them authority to access the SIDA and secure areas without an escort. Any other worker needing to enter the SIDA or secured area must be accompanied by an escort who has been granted unescorted access authority.
- For many reasons, the visibility of many of an airport's security measures is not readily apparent or open to the untrained or uninitiated. To determine if a site is AOA capable is typically a collaborative effort between the various security stakeholders. If airport property is to be used for other non-aviation purposes, these same stakeholders should still have an opportunity to comment on potential impacts to the airport's overall security. These impacts will vary depending on the site and proximity to existing airport perimeters.

4.2 Physical and Environmental Considerations

Physical planning for any collateral development must be done within the context of the Master Plan and the approved Airport Layout Plan (ALP). On-airport development therefore becomes somewhat more problematic in that it faces certain constraints that must be addressed in order not to potentially trigger a large environmental review process which could create substantial delays in project implementation. The preferred course of action is to select a site that will enable the development to proceed with all appropriate environmental due diligence on a timely basis. The site must not adversely impact airport operations or safety. It should be as proximate as possible to the aeronautical functions for which it is intended to provide support without creating or complicating security issues. Lastly, it should be sited to facilitate doing business and maximizing revenue.

Impacts on roadway access to the site and to the airport should be carefully evaluated to minimize adverse impact on traffic flows keeping in mind overall effects on airport constraints. Critical construction issues such as cut and fill and water table levels will play an important part in site selection and in many instances, a separate cost benefit analysis on cut and fill problems may be required. The site selection should also be sensitive to water table issues, drainage and consider containment issues if there has been a possible use of contaminants in the site. The ability and cost to pull utilities including water to the site is another important consideration. Should special communications infrastructure be required, its unique access issues must be weighed.

One of the greatest difficulties for an airport is balancing the need to accommodate growth with concerns for remaining environmentally friendly. The issues pertain to alternative land use as well as the core business elements. These include noise, light and emissions as well as all the other issues mentioned below. While there may not always be direct relevancy, a quick check of a contemplated initiative against the regulations might be worthwhile.

Waters and Wetlands

Back to Table of Contents

- Pursuant to the Clean Water Act, development alternatives should avoid and minimize impacts on water and certain wetlands and should not cause water pollution. In some cases, impacts can be offset by the acquisition of mitigation property, but cost-benefit then becomes a critical part of the analysis.

Air Quality

- Pursuant to the Clean Air Act, the proposed development should not cause the degradation of air quality. This means that detailed analysis may be required for accessing roads regarding traffic levels and emissions.

Bird Attractants

- Water impoundments, garbage dumps, sanitary landfills, sewage treatment plants and certain species of flora and fauna often attract birds. The presence of many birds around airports increases the risk of bird strikes.

Noise

- As perceived, the greatest single concern near an airport is the impact of noise. Therefore, the identification of alternative land use must consider compatibility with different levels of noise exposure as identified in FAR Part 150:

Land Use Compatibility with Yearly Day-Night Average Sound Levels

Legend:

Y (Yes) - Land use and related structures compatible without restrictions N (No) - Land use and related structures are not compatible and should be prohibited

NLR - Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure

DNL -Average Day-Night Sound Level

25, 30, 35 - Land use and related structures generally compatible; measures to achieve NLR of 25, 30, 35 dB must be incorporated into design and construction of structure.

Land Use	Below 65	65-70	70-75	75-80	85-85	Over 85
Residential						
Residential, other than mobile homes and transient Lodging	Y	N (1)	N (1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N (1)	N (1)	N (1)	N	N
Public						
Schools	Y	N (1)	N (1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y (2)	Y (3)	Y (4)	Y (4)
Parking	Y	Y	Y (2)	Y (3)	Y (4)	N
Commercial						

Back to Table of Contents

Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail - building materials, hardware and farm equipment	Y	Y	Y (2)	Y (3)	Y (4)	N
Retail trade – general	Y	Y	25	30	N	N
Utilities	Y	Y	Y (2)	Y (3)	Y (4)	N
Communication	Y	Y	25	30	N	N

Land Use	Below 65	65-70	70-75	75-80	80-85	Over 85
Manufacturing & Production						
Manufacturing – general	Y	Y	Y (2)	Y (3)	Y (4)	N
Photographic and optical	Y	Y	25	30	N	N
Agricultural (except livestock) and forestry	Y	Y (6)	Y (7)	Y (8)	Y (8)	Y (8)
Livestock farming and breeding	Y	Y (6)	Y (7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y (5)	Y (5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusement parks, resorts and camps	Y	Y	Y	N	N	N
Riding stables and water recreation	Y	Y	25	30	N	N

Source: FAR Part 150, Appendix A, Table 1

Notes:

1. When the community determines that residential or school use must be allowed, measures to achieve an outdoor to indoor NLR of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year-round. The use of NLR criteria will not, however, eliminate outdoor noise problems.
2. Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas or where the normal noise level is low.
3. Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas or where the normal noise level is low.
4. Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas or where the normal noise level is low.
5. Land use is compatible provided special sound reinforcement systems are installed.
6. Residential buildings require an NLR of 25 dB.
7. Residential buildings require an NLR of 30 dB.
8. Residential buildings are not permitted.

Physical Considerations

The same kinds of issues for any construction project on an airport will pertain to alternative land use. All the critical elements linked to airport operations must be weighed in the installation of any new non-traditional land use.

- Geographic Constraints
  - The most obvious issue is whether there is enough property and whether it is properly configured to accommodate the proposed use. If there is not a good fit or the site does not have good visibility or

Back to Table of Contents

access, then an alternative use should be considered.

- Cut and Fill
  - Having an available site is only the first step. Few sites are perfectly suited to immediate development. The nature of the potential development may require atypical grading, or the site itself may require work for routine development. Associated costs, if too high could eliminate prospects for development.
- Water Table
  - If the development requires any below-grade work to include storage, parking, access etc. the water table will be critical. Often the airport will have complete information on this, but certain sites may require additional testing and examination.
- Soils
  - The nature of the soil may impact construction costs for certain uses. For example, in some areas pilings may be required. The associated costs could easily double typical foundation expenses and impact on the financial feasibility of the development.
- Utilities
  - Development locations on the perimeter of the airport may affect both the availability of utilities and from whom they are supplied. In either case the costs must be determined for bringing the utilities to the site and the monthly costs.
- Access
  - It is important that the development use be consistent with the availability of ground access to and from the site. The roadway must have both the capacity and geometry to accommodate the use and not interfere with projected access to aviation uses and operations.
- Ground Traffic Level of Service
  - Level of Service is critical for several reasons:
    - The amount of traffic generated by the development must be consistent with the levels dictated by the airport's environmental plan.
    - The additional traffic that the new use generates should not adversely affect traffic flows to the airport's primary aviation facilities.
    - The traffic flows should not create congestion on the access roads to the project site.
    - The projected levels of traffic should ensure that carbon emissions are within airport and/or regional parameters.

4.3 Outreach Considerations

Public Relations

Communities look at their airports very differently. In many instances an airport will be surrounded by or possibly be part of separate municipalities that have different perceptions of the appropriate role of the airport. This flows into development initiatives that blur the lines and may create conflict between airport and commercial activity.

- Surrounding Residential Community
  - An airport always must be sensitive to the surrounding community. Alternate land use implies the development of a non-traditional airport business with most typically, a commercial orientation. The absence of community resistance to a proposed use will be a positive step in its success. A use compatible with regional interests and needs should be an important criterion in the evaluation of development alternatives.
- Business Community

Back to Table of Contents

- Any commercial use of airport property has the potential to compete with private sector initiatives. This is particularly sensitive at airports with substantially developed surrounding properties. While there may be airport development opportunities, the possibility for competing development should be addressed before planning advances too far. This should include an understanding of tax implications or where applicable Payments In Lieu Of Taxes.

- Political Community
  - There is considerable potential for raising concern in political areas. When communities have an issue with any element of the development, it is very likely that the debate will be escalated to a political level. The airport should anticipate the potential for such escalation and address the concerns before they become problems.

5. Federal Laws and Regulations Relating to Airport Compatible Land Use Planning

The most difficult elements of determining the feasibility of alternative land use involve ensuring consistency with appropriate federal and other legislative guidelines which form safety, security, and operational planning parameters for airports. In identifying potential alternative land uses for airport property, airport management must therefore comply with various laws and regulations. This section summarizes federal laws and regulations that must be considered in planning airport land use. In addition to federal laws and regulations, there are various state and municipal laws and regulations that also govern and/or inform airport land use planning.

Aviation Safety and Noise Abatement (ASNA) Act of 1979

- Congress passed the ASNA Act to aid airport owners in preparing and carrying out noise compatibility programs primarily to ensure continued safety in aviation. The ASNA Act required the following actions:
  - Establishment of a single system of measuring noise at airports and the areas surrounding airports
  - Establishment of a single system for determining exposure of individuals to noise, noise intensity, duration, frequency and time of occurrence; that results from airport operations
  - Identification of land uses normally compatible with various levels of exposure to noise
  - Section 103 of the ASNA Act authorized the Secretary of the Department of Transportation to make grants for airport noise compatibility planning to minimize noise impacts on communities in and around airports.

Airport and Airway Improvement Act (AAIA) of 1982

- The AAIA obligates airport owners who accept federal funding to operate and maintain the airport and comply with specific assurances, including the establishment and maintenance of compatible land uses around airports. The airport owner must restrict the use of land adjacent to or in the immediate vicinity of the airport to reasonable activities and purposes compatible with normal airport operations, including aircraft landings and takeoffs.

Airport Noise and Capacity Act of 1990

- Noise complaints from the public prompted Congress to establish a National Noise Policy that required the phase out of Stage 1, Stage 2 and the use of all Stage 3 aircraft in the United States effective December 31, 1999.

National Environmental Policy Act of 1969 (NEPA)

- The NEPA established the commitment of the federal government to fully consider the effects of a proposed action on human environment. It states that “governments, and other public and private organizations, use all practical means and measures to create and maintain conditions under which man and nature can exist in harmony.” The NEPA resulted in the development of guidelines for the application of a national policy to consider the impacts of a proposed project or action on the environment.

- In land use planning, NEPA comes into play when an airport sponsor proposes a project or action that requires federal approval. All actions proposed by an airport sponsor are reviewed to determine whether

Back to Table of Contents

there are environmental impacts that may result from the action being implemented and if these impacts are significant.

Section 404 (b) (1) of the Clean Water Act of 1977

- This Act provides for the protection of waters and wetlands of the United States by ensuring that development alternatives to avoid and minimize impacts on waters and wetlands have been considered.

Section 401 of the Clean Water Act of 1977

- This section of the Act ensures that any activity that may result in a discharge of a pollutant into waters of the United States be evaluated for its effects upon water quality and compliance with federal and state effluent limitations and water quality standard requirements of the Act. For example, storm water run-off is a concern at airports because of refueling and de-icing activities and impervious surfaces.

The Clean Air Act Amendments of 1990

- As amended in 1990, the Clean Air Act established national air quality standards. Aircraft emissions do not significantly contribute to air pollution, but automobile emissions do. Airports, and developments at or near airports, can draw significant automobile traffic and truck traffic.

The Endangered Species Act of 1973

- This Act ensures that proposed projects or land uses do not jeopardize the continued existence of or result in the destruction of any designated critical habitat for threatened or endangered species. Endangered and threatened species often find or have established habitat in and around airports.

National Historic Preservation Act of 1969

- This Act directs the federal government to provide leadership in preserving, restoring and maintaining the historic and cultural environment of the nation. This Act also authorizes the Secretary of the Interior to expand and maintain a National Register of districts, sites, buildings, structures and objects significant to American history, architecture, archeology and culture. Homes or properties to be acquired or altered for a proposed airport development are subject to review under Section 106 of this Act.

Noise Compatibility Program, Code of Federal Regulations (CFR) Title 14, Part 150

- Initiated by the Federal Aviation Administration (FAA) in 1981 and revised effective January 18, 1985, Part 150 provides financial assistance to airport owners to assess noise impacts and to identify and carry out noise-reduction measures. Part 150 established a standardized airport noise compatibility program that includes:
  - Voluntary development and submission to the FAA of noise exposure maps (NEMS) and noise compatibility programs (NCPs) by airport owners
  - Standard noise measurement methodologies and units
  - Identification of land uses that are normally compatible (or incompatible) with various levels of aircraft noise around airports
  - Procedures and criteria for preparation and submission of NEMs and NCPs.
- The Final Rule states that Part 150 regulations apply to any “public use airport” as defined by Section 502 (17) of the Airport and Airway Improvement Act of 1982.

Notice and Approval of Airport Noise and Access Restrictions, CFR, Title 14, Part 161

- Part 161 establishes the implementation of the Airport Noise and Capacity Act of 1990

Objects Affecting Navigable Airspace, CFR Title 14, Part 77

- Tall structures (including buildings, construction cranes and cell towers) are hazards to aircraft navigation. Part 77 sets standards for determining obstructions to navigable airspace. It provides for studies of obstructions to determine their effect on the safe and efficient use of airspace, conduct of public hearings regarding these obstructions, and creation of antenna farm areas. Part 77 also establishes methods for identifying surfaces that must be free from obstructions.

Back to Table of Contents

General Operating and Flight Rules, CFR Title 14, Part 91

- Part 91 establishes general rules for the operation of aircraft regarding different types of airports and different types of flight. These rules translate into specific spatial requirements for safety areas.

Hazardous Wildlife Attractants On or Near Airports, FAA Advisory Circular (AC) 150/5200-33C

- Bird strikes during flight and the interaction of terrestrial and avian species with aircraft on the ground are hazards to aviation. This AC provides guidance regarding the types of land uses that are considered incompatible to airports due to their nature as wildlife attractants. These uses include, but are not limited to: wastewater treatment facilities, wetlands, dredge spoil containment areas and solid waste landfills. These uses must not be located within 10,000 feet of a runway that serves turbojet aircraft, or within 5,000 feet of any airport runway end used solely by piston-type aircraft.

Proposed Construction or Alteration of Objects That May Affect the Navigable Airspace, FAA AC 70/7460- 2J

- Planners must be aware of the various critical safety considerations when siting development in and around airports. All construction activities at or near federally obligated airports must be reported to the FAA via Form 7460-1 at least 90 days before the proposed construction or application for building permit. The FAA conducts an aeronautical study and issues a determination of whether the proposed development is a hazard.

Airport Land Use Compatibility Planning, FAA AC 150/5060-6

- This AC guides the development of a compatibility plan to ensure the environment surrounding an airport is not developed in a manner that could pose risk to airport operations. This document specifically looks at land use and noise issues.

Airport Master Plans, FAA AC 150/5070-6A

- This AC guides the development of airport master plans with the objective of developing safe and efficient airports using acceptable standards. The document calls for an integrated approach to airport development planning where airside and landside issues must be equally evaluated to create a plan that provides for compatible airport and community development.

A Model Zoning Ordinance to Limit Height of Objects Around Airports, FAA AC 150/5190-4A

- This AC provides sample language and models for zoning ordinances to limit the height of objects around airports. The height limits are based upon the surfaces described in Subpart C of FAR Part 77.

Airport Design, FAA AC 150/5300-13 Change 7

- The AC provides basic standards and recommendations for airport design.

Noise Control and Compatibility Planning for Airports, FAA AC 150/5020-1

- This AC provides guidance for the implementation of FAR Part 150, which allows for the development of a plan to establish compatibility between surrounding land uses through the reduction of non-compatible land uses around airports and noise-sensitive areas, and the prevention of additional non-compatible land uses.

Airport Landscaping for Noise Control, FAA AC 150/5320-14

- This AC establishes guidance for the implementation of landscaping for noise control purposes and recommends various species of vegetation to be used for noise control.

U.S. Standards for Terminal Instrument Procedures (TERPS), FAA Order 8260.3 B change 14

- The order contains standards for establishing and designing instrument flight procedures.

Airport Environmental Handbook, FAA Order 5050.4A

- This FAA Order establishes the instructions and guidance for preparing and processing environmental assessments (EA), finding-of-no-significant-impacts (FONSI) and environmental impact statements (EIS) for proposed airport development requiring federal environmental approval. Over twenty categories of impacts are evaluated as part of this process:

Back to Table of Contents

- Compatible land uses: defined as “the compatibility of existing and planned land uses in the vicinity of an airport and are usually associated with the extent of the noise impacts related to the airport.”
- Social impacts: associated with relocating residences or businesses, altering surface transportation patterns, dividing or disrupting established communities or disrupting orderly planned development.
- Induced socioeconomic impacts: address such issues as population movement and growth, public service demands, and changes in business and economic activity resulting from the proposed airport development.
- Environmental justice: intended to identify, address and avoid disproportionately high and adverse human or environmental effects on minority and low-income populations.
- Air quality: addresses compliance with Clean Air Act national air quality standards; required for airport development projects that involve airport location, runway development, physical airside or landside improvements that increase airport capacity, or any proposed development that does not conform to an approved state implementation plan for controlling area-wide air pollution impacts.
- Water quality: addresses compliance with Clean Water Act water quality standards and ensures that the quality of ground and surface water is not degraded by planned construction.
- Department of Transportation, Section 4(f): provides that no program or project requiring the use of any publicly owned land from a public park, recreation area or wildlife or waterfowl refuge, will be permitted unless there is no other alternative and that planning of such program or project includes plans to minimize harm resulting from the use of the property. This legislation has been superseded by Section 303© of Title 49, USC, but the criteria remain the same.
- Historical, architectural, archaeological, and cultural resources: address compliance with the requirements of the National Historic Preservation Act of 1969
- Biotic communities: intended to protect biotic communities, including native and introduced plants and animals in the project area.
- Endangered/threatened species of flora and fauna ensures that proposed projects do not result in loss of habitat for endangered or threatened species, pursuant to the Endangered Species Act, Section 7, as amended.
- Wetlands: areas inundated by surface or ground water with a frequency sufficient to support, and under normal circumstances do or would support vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.
- Floodplain: defined as “the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands that are subject to a one percent or greater change of flooding in any given year.”
- Coastal zone management: to preserve and protect the nation’s coastal zone, to encourage wise use of land and water resources of a coastal zone, to prepare a plan to provide protection of natural resources and coordination of the public, federal state, local interstate and regional agencies and governments affecting the coastal zone.
- Coastal barriers: The Coastal Barriers Resources Act of 1982, PL 97-348, prohibits, with some exceptions, Federal financial assistance for development within the Coastal Barrier Resources System, which consists of undeveloped coastal barriers along the Atlantic Ocean or Gulf Coasts.
- Wild and Scenic Rivers: The Wild and Scenic Rivers Act describes those river areas eligible to be included in a system afforded protection under the Act as flowing and possessing “outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values.”
- Farmland: The Farmland Protection Policy Act authorizes the Department of Agriculture to develop criteria for identifying the effects of Federal programs on the conversion of farmland to non-agricultural uses.
- Energy supply and natural resources: Energy requirements generally fall into two categories: those which relate to changed demands or stationary facilities (e.g. airfield lighting and terminal building heating), and secondly, those which involve the movement of air and ground vehicles. For most

Back to Table of Contents

airport actions, changes in energy or other natural resource consumption will not result in significant impacts.

- Light emissions: consideration of any lighting associated with an airport that will create an annoyance to people in the vicinity. An assessment should consider site location, type of system, and measures to lessen annoyance.
- Solid waste impacts: consideration of solid waste impacts; consultation with local officials concerning solid waste disposal facilities must be documented in the environmental assessment.
- Construction impacts: consideration of adverse environmental impacts including noise, dust, air pollution from burning debris and water pollution from erosion.
- Design, art, and architectural application: aesthetic enhancement and mitigation of adverse visual and other environmental impacts. FAA's Airport Improvement Program Handbook prescribes guidelines for treating and promoting design, art, and architectural objectives in AIP funded airport development projects.

6. Roles and Responsibility of Stakeholders

There are many entities involved in airport land use planning. This section identifies the different stakeholders and their corresponding roles and responsibilities.

Federal Aviation Administration

While the Federal Government does not have direct control over zoning and regulating development around airports, it provides planning guidance, technical assistance and funding for promoting compatible land use. At the federal level, the FAA is the primary agency responsible for promoting aviation-related land use compatibility. The FAA is responsible for federal laws and regulations affecting the aviation industry through the issuance of Federal Regulations, FAA Orders and Advisory Circulars (ACs). Specific FAA regulations and their impact on land use issues provide the foundation for airport owners when developing a land use strategy. The FAA also provides funding for the development of master plans, noise and land use studies, and environmental studies for airport development projects, and the expansion and safe operation of airports and related aviation facilities. As the governing aviation agency, the FAA is responsible for the preservation of the national airspace and control of aircraft while in flight.

In promoting land use compatibility, FAA's funding priorities are as follows:

- First, acquisition of clear runway safety areas and approach areas near the airport
- Second, acquisition of easements to provide height controls over properties near the airport
- Third, when warranted by a noise study, noise mitigation measures, which may include soundproofing structures, construction of noise barriers, or possibly acquisition to remove or relocate a noise - sensitive development

Despite the FAA's important policy, oversight and funding roles, local governments retain full control and jurisdiction over the use of land outside an airport's boundaries. The FAA's only leverage for promoting compatible land use planning off-airport is through the grant assurances that airport owners must sign to obtain federal funding for airport improvements. These grant assurances typically include promises or efforts by the airport operator to ensure that surrounding local governments will impose adequate zoning and land use controls to protect the airport.

It is also important to remember that the FAA, which is charged with maintaining the aeronautical capacity of the U.S. airport system, typically must approve non-traditional uses of airport property.

State Government

Some states issue guidelines for compatible land use planning around airports. State agencies that may be involved in compatible land use planning include the department of aviation, department of transportation, department of land conservation and development, department of environmental quality, department of fish and wildlife, and department of state lands. Typically, the States play a limited direct role regarding on-airport development but can have substantial input nonetheless through integration with off-airport planning initiatives and infrastructure projects.

Back to Table of Contents

Local Government

Local governments are charged with local land use zoning and control. They are responsible for preparing comprehensive land use plans and reviewing and implementing zoning and land use regulations in a manner that considers effects on local airport facilities and aviation activity. They have the ultimate authority to approve or disapprove a particular regional land use. Accordingly, the relationship between local jurisdictions and airports is of critical importance because airport operators rely upon local government staff to provide notice of land use actions near airports and establish planning and zoning policies that enable airports to operate effectively and safely.

Airport Owner / Operator

The airport owner/operator is responsible for land use planning and development on-airport. It is responsible for working with independent local governments and citizens to protect the airport from incompatible land uses in the airport's vicinity. It is responsible for informing the public of the importance of compatible land use planning around airports; preparing master plans, noise compatibility and land use studies; implementing community involvement programs; and interacting with local planners and government officials. When receiving federal funding, the airport owner/operator must ensure compliance with grant assurances relating compatible land use planning and development, and the protection of navigable airspace. The airport must also play a role in ensuring that its own development does not have an adverse impact on regional off-airport development opportunities and economic growth.

Property Owners

Owners of properties near the airport should participate actively in decision-making pertaining to local land use planning and zoning. Owners who might seek to undertake residential or other commercial developments that are potentially incompatible with airport operations must work closely with local airport operators and stay abreast of airport improvement plans. They should seek advice and input from airport operators in planning new development so that it can be configured to reduce or eliminate potential incompatibility. Similarly, on-airport development initiatives can be coordinated with off-airport projects to ensure optimum regional benefit.

Local Citizens

The role of local citizens is to understand the issues affecting airport operations and the importance of maintaining compatible land uses near and with the airport. Local citizens influence the decisions of local planners and policy makers.

Airport Users

Passenger airlines, cargo and combination carriers and general aviation users need to be aware of issues relating to land use compatibility. Airlines are required to replace or retrofit aircraft to reduce noise and air quality impacts. Pilots are responsible for operating aircraft according to noise abatement procedures established at an airport and the local airspace. Other tenants, who basically are leaseholders, must ensure that their operations are consistent with regional land use requirements, and that their potential expansion does not adversely impact conditions in the surrounding communities.

7. Planning and Prioritizing

The successful development of airport property for activities ranging from ancillary and support activities to logistics parks hinges on the effective integration of several critical planning considerations. The backbone to proper planning and prioritization is a sound business plan with clearly defined goals and objectives with well-understood priorities. A simple acronym used in this process is SMART:

- **S**pecific – The objectives clearly state what the airport wants to achieve
- **M**easurable – The results that are achieved can be clearly measured against a predetermined target
- **A**chievable - The objectives that have been set are realistically achievable and attainable
- **R**ealistic – The objectives that have been set can be met with available resources
- **T**ime – When do you want to achieve the set objectives?

If a priority is not assigned to each objective, then it is difficult for the airport to make the most politically

Back to Table of Contents

acceptable and fiscally prudent decision when these objectives compete for resources, as to how best to allocate money, people, land, and equipment.

Correlation with the Airport Business Plan

An airport typically has a wide variety of constituents to serve and objectives to meet. Accordingly, Airport Authority Business Plans should contain well thought-out objectives and strategies associated with the following. There may be others and the priorities may vary, however some of the examples are:

- Customer service
- Security
- Safety
- Revenue
- Job creation
- Improving cargo facilities efficiency
- Improving the regional transportation and logistics sector

All these objectives are important, and their prioritization is essential to make the correct decisions when allocation decisions on land use are made. This is the foundation to a successful development plan; close attention to detail can help preserve the success of any commercial development initiative.

Correlation with Airport Master Plan

The Airport Master Plan determines where on the airport's property key activities and developments will occur. The plan both reflects and impacts the potential operations and services available to current and future tenants; it should be well thought-out and integrated with sound business planning principles.

There are several important considerations to keep in mind when developing and reviewing the Airport Master Plan for possible non-traditional land uses to include such concepts as a logistics park:

- The site should demonstrate compatibility between intended land use and airport operations (e.g. line of sight, noise exposure, electronic, radar, navigational systems)
- The site should be of sufficient size to meet development requirements
- If the development is a large and/or relatively busy facility such as a logistics park, road access to, from, and within the property should be carefully evaluated
- Clear linkages to create synergy between a park and airport tenants and operations, and where possible the surrounding community should be created
- Positive impacts on airside efficiency should be created by the development
- Apron connectivity, if appropriate should be efficient and secure

Correlation with Regional Transportation Plan

The value of property and the success of a development are heavily linked to its road access. Types of land use are more sensitive to access. For example, successful commercial properties require clear visibility and access to major thoroughfares.

Due to this importance, it is critical to ensure that the organizations that are responsible for planning roads, overpasses and highways in the region are aware of the airport's plans and vice versa. It is also critical that the airport forges working relationships with these groups to influence the decision-making process and ensure that its needs are met. Because these relationships can be so critical to both the timely implementation and success of a project, airports should be sensitive to several regional transportation planning considerations:

- Understand the roles that different organizations have in planning and maintaining the regional roadway system and how their plans are developed and communicated
- Identify the travel times and connectivity requirements for present and future tenants to the major

Back to Table of Contents

thoroughfares and highways

- Understand the impact of development on current traffic and how much new volume the development may generate
- Have an access plan to enable tenant employees to get to work

Correlation with Regional Land Use Plans

It is important to understand the present and anticipate the contemplated land uses around the airport. Potential use conflicts can stall and even stop development. Items like tractor/trailer traffic associated with commercial land use and airport noise tend not to mix well with residential property. There are some very basic subjects to be considered when exploring new development opportunities. These can include, but are not limited to:

- Compatibility/synergy with existing off-airport uses
- Conflicts with different types of off airport property usage
- Effective use of landscaping, screening, setbacks to help reduce cost and optimize land utilization
- A detailed market analysis to determine the different tenants interested in your development
- Developmental timetable to coordinate scheduling and reduce delays
- Optimization of coverage to ensure all land is allocated
- Awareness of potentially conflicting multiple municipality concerns
- Flexibility to meet shifting user demand to minimize redefinition of allocated space

There is a very real potential for off-airport property owners to view any collateral on-airport development as a threat. If potential resistance from this sector is not effectively addressed at the beginning stages of a project, the resultant resistance may cause a development initiative to fail.

8. Development Options

As airports examine the physical and operational elements of alternative land uses, it is extremely important that the basic business elements be addressed: the market and financial feasibility of the project, possible involvement of a third party and securing the financing for the development.

Project Feasibility

There are some very important considerations that an airport should examine when evaluating feasibility:

- Level of existing demand for the development that has been expressed by tenants, or by a private investor seeking to undertake development
- The expectation that the level of demand will remain sufficiently high to sustain the development
- Indirect and direct revenues that will result from the new development (e.g. land rent revenue, landing and parking fee revenue increases). In an ideal situation, any new development will help grow and sustain primary components of airport business
- Direct and indirect costs associated with the development (e.g. servicing the land, planning, acquiring engineering services, construction, etc.)
- The airport's expected rate of return or payback period on capital expenditures
- Comparative development costs for the private sector
- Net present value and payback period for the development

The key to most internal approval processes is to have the project's benefits quantified and linked directly to the Business Plan. For example, the economic impact of a new logistics park can be expressed in terms of tax dollars, potentially greater cargo volumes, or regional jobs. These numbers can be weighed against the cost and the benefits of other competing regional projects.

Back to Table of Contents

Airport Financial Status

Most airports are public entities which eliminate several traditional financing options. Many large airport projects require the issuance of debt to finance the necessary capital expenditure. Typically, an airport will need to determine its financial position and its ability or inclination to service debt considering other projects that may be competing for funding. Financially speaking, an airport should consider the following ratios in examining the financial feasibility of a development.

Profitability Ratio – is the amount of the airport's revenues that are profit.

Gross Margin percentage = 100 * (Revenue - Cost of Goods Sold) / Revenue

Current Debt Ratio – expresses the capacity of the airport to pay its short-term (e.g. next 12 months) debt.

Current Ratio = Current Assets/ Current liabilities

An acceptable ratio varies by industry. If the airport's Current Ratio is 1.75, it means that for every dollar the airport owes it has $1.75 available in current assets. A value greater than 1 means that the airport is positioned well financially, while something less than 1 indicates that there may be problems meeting short-term obligations.

Interest Coverage Ratio – reflects the ability of the airport to pay interest on outstanding debt.

Interest Coverage Ratio = (Revenue – Expenses)/ Interest Charges

This number is arrived at by dividing the airport's earnings before interest and taxes (EBIT) for a year by the interest expenses for the same year. It is the number of times over that, that the airport can pay for its debt. Typically, the preferred number is greater than 1.5.

Cost of Private Money

Debt issuers will use these same ratios to analyze the credit risk associated with the airport and the investment. The risk associated with the airport impacts the availability of these funds and the interest expense. There are other potential external sources of financial resources that include:

- Federal and/or state funding
- Alternate funding sources
- Private funding

The Final Decision

Ultimately, the decision of how to proceed with development can be reduced to two considerations: risk and return.

The Airport's return from the project will depend on whether a private developer is involved. If no developer is involved, then all revenues generated by the facility would be expected to accrue to the Airport. This would hold true even if the Airport were to hire a firm to manage the facility, in which case the management fee paid to the firm would be in the form of facility-related expenses. And while the Airport's return is in principle not capped, the Airport's exposure to cost increases and revenue decreases is equally not limited. In contrast, when a developer constructs and operates a facility the return to the Airport is typically a fixed (albeit possibly escalating) payment.

As with its return, the Airport's facility-related risks will depend on several factors including (perhaps most importantly) whether the project should be executed by a developer or by the Airport itself.

Back to Table of Contents

Airport Risks	Airport Development Significant vacancy risk Balance sheet exposure Capital outlay Completion risk Liability issues Operating costs Marketing costs Relocation costs Environmental costs	Third Party Development Some vacancy risk No exposure Lower revenues Developer credit risk (ground rent) Environmental costs No control over tenant rents/costs
Developer Risks	Not applicable	Securing financing Significant vacancy risk Completion risk Operating costs Marketing costs Relocation costs

In the absence of a developer, the Airport's risk-return profile may be likened to that of equity in that returns generally increase in relation to the commercial success of the project, but the Airport assumes all the risk of commercial failure of the project. Generally, this is not substantially changed by the retention of a firm to manage the facility on the Airport's behalf. With the involvement of a developer, the Airport's risk-return profile may be likened to that of debt in that returns generally are specified in advance and are largely independent of the commercial success or failure (short of bankruptcy) of the project. The Airport gives up the upside potential for protection from downside risk.

One of the keys to building a new facility will be the cost of capital for whoever develops the facilities. Potential tenants sometimes raise concerns over the use of a new cargo facility particularly if a third-party developer is used.

Typical Issues Regarding Third Party Development

The following issues are typically raised regarding third party development:

- Third Party Development will cost more and translate into higher rents than if the Airport builds the Facility.
  - **Facts:** Even though developers take their returns and a management fee, their cost of development is typically less than an airport's. Much will depend on the flexibility the airport shows in its revenue target setting. In considering those targets it is important that the airport factor in other potential revenue generators such as additional landed weight and fuel flowage fees. Pragmatically speaking, an RFP can indicate that impact on tenants is a concern and require the respondents to detail in their proposals the costs that will accrue to potential tenants. This will give the Airport definitive information if carriers or other potential tenants raise concerns.
- A Third Party will not be as knowledgeable or as concerned about tenant issues and costs as the airport.
  - **Fact:** Third party development generally reflects a step forward in private/public partnerships, allowing the airport to focus its attention and resources on passengers, while the developer can focus time and resources on the project. In any industry, failure to provide good service and be responsive to tenant needs will put a developer out of business.
- The airport will not make as much money if a third party builds and operates the facility.
  - **Fact:** This is accurate but overlooks the fact that the airport will not have any capital outlay. The appropriate approach is to optimize revenue so that the airport and the developer achieve fair returns while maintaining an equitable rent structure that does not gouge tenants. Developers are

Back to Table of Contents

in business to make money and so will not create a financial structure that discourages leasing. Once again, the airport will have control over the selection of a developer, and the selection will at least in part be predicated upon the rental rates and fees for tenants.

- A third-party development might not meet the airport's/tenants' needs.
  - **Fact:** No successful developer would propose on or undertake a project without first speaking to every existing tenant in the area if not on the airport, and every potential tenant he can identify. Further, if existing tenants have issues that they believe should be considered as part of a new development, then, assuming that they are reasonable, these could be included in the RFQ/RFP.
- Letting a third party onto the Airport to make money is a misuse of a public asset.
  - **Fact:** As evidenced by industry trends, third party development is an effective way to help airports optimize their scarce resources and cannot reasonably be categorized as a misuse of a public asset. Such development is consistent with airport mandates to provide service while accommodating growth and demonstrating fiscal prudence.
- A new facility will cost more to lease.
  - **Facts:** That will probably be the case regardless of who builds the facility. But if the existing buildings are old that is to be expected. If a third party builds the facility, a large percentage of the rent will be tied to the amount of ground rent that the airport seeks to recover, and the length of the lease itself. If the prospective tenants argue that age doesn't matter, and that they just need the space to do business, then any concerns they might express about security, operations, service, etc. would seem less substantive.

Comparative Cost Models

There are several important financial considerations in comparing third party development to airport development that extend beyond the total cost of building the project.

- The term of the master lease: If the airport pursues third party development, the longer the period of amortization the easier it is for the developer and the Airport to achieve targeted returns while keeping the rental costs to the tenant lower.
- The cost of the ground lease: The cost of the dirt is typically passed directly through to the tenants. To keep building rents under control, the revenue targets of both the developer and the airport must be realistic. A high ground rent will often discourage third party development.
- Operations and maintenance costs: These reflect the costs of maintaining and operating the facility, including roadways and aeronautical infrastructure. The costs plus a management fee are typically passed on directly to the tenants on a pro-rated basis.

The key differences between the financial assumptions where the airport has capital responsibility for a facility versus the third-party development are:

- The private sector can often construct a facility for ten to fifteen percent less than the public sector because of a faster decision-making process and the ability to negotiate modification of construction and bid prices.
- Private sector soft costs will be around five percent less than if the airport were to undertake the project.
- The third party will pay the airport ground rent for the footprint of the building and associated space such as employee parking. The third-party developer will recover this cost through space rent to building tenants.

Things to Remember

Even if the airport can afford to self-develop a cargo or logistics project, there is still merit to considering use of a third-party developer who can:

1. Share the financial risk
2. Add development expertise

Back to Table of Contents

3. Provide market intelligence
4. Include experience from other development markets
5. Provide tenants

It is not always easy for an airport to balance the above benefits with a more limited role in project control. A developer is typically a private company that has profits to consider for its investors. While available labor might be critical, job creation is not normally a high priority. This could be a potential cause for concern. If a developer is allowed to take full control of the development, then the airport's ability to impact other goals is reduced. However, an appropriate level of control can be easily incorporated into a development agreement.

It is also important to consider conflict with off-airport projects and timing. It is essential that the airport knows the local industrial real estate market. This could include regular meetings with brokers and developers in the market to align efforts. An airport can request that local brokers provide copies of their market overviews that typically include key market indicators such as:

- Vacancy Rate
- City Total Inventory
- Construction in the current quarter
- Construction expected in the next year

Understanding the local market will reduce the likelihood of a development simply flooding the market, optimize the productivity of the land, meet higher levels of customer service, and generate greater levels of revenue on a timelier basis.

Back to Table of Contents

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Back to Table of Contents

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Back to Table of Contents


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