CHAPTER 4

AIR CARGO FACILITY ANALYSIS

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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 answering 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. To develop 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, andthe support of the forwarder community is important. Some airports are offering incentives to new entrants but keep in mind thatthe 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 GSE space as well as the 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 also 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

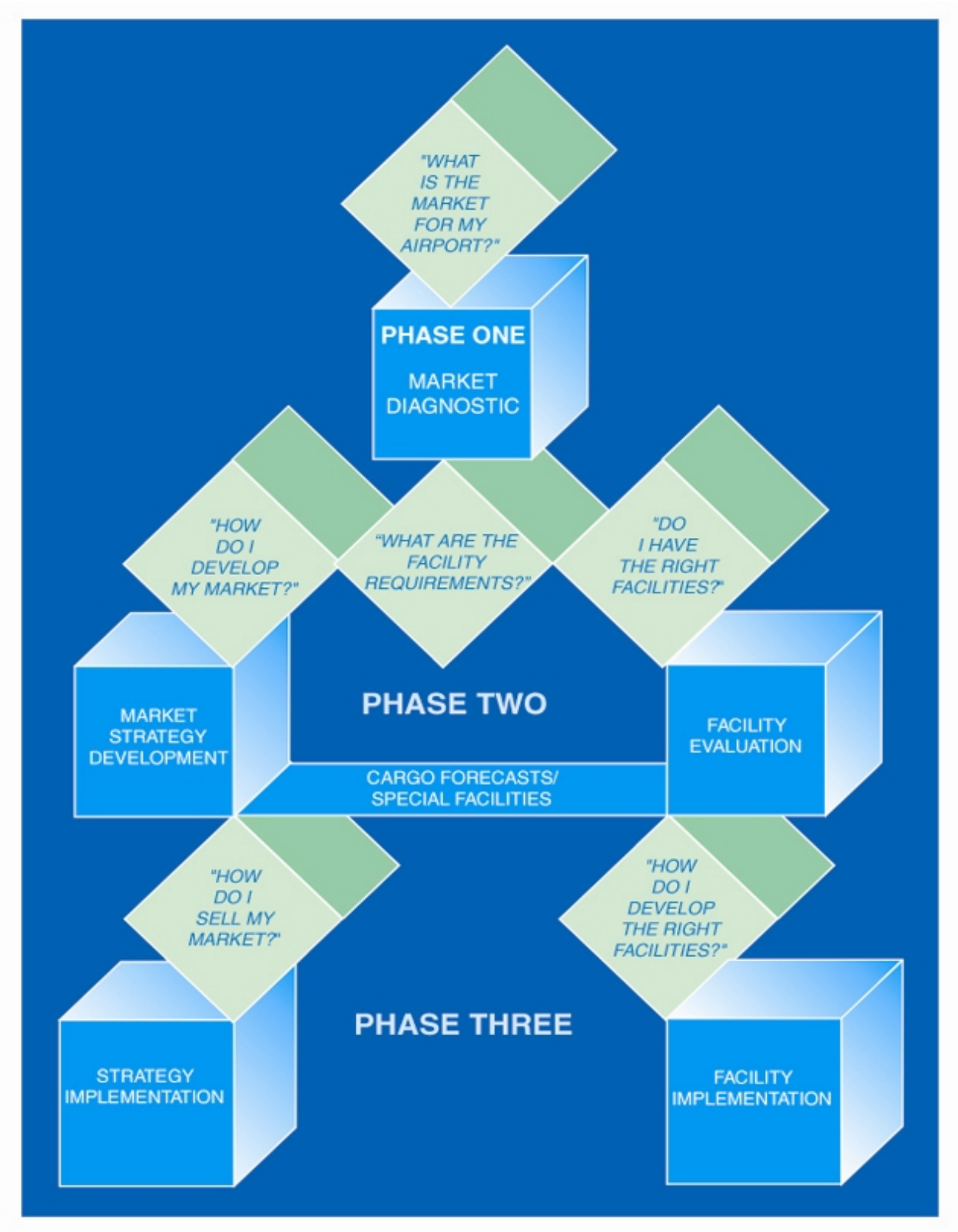
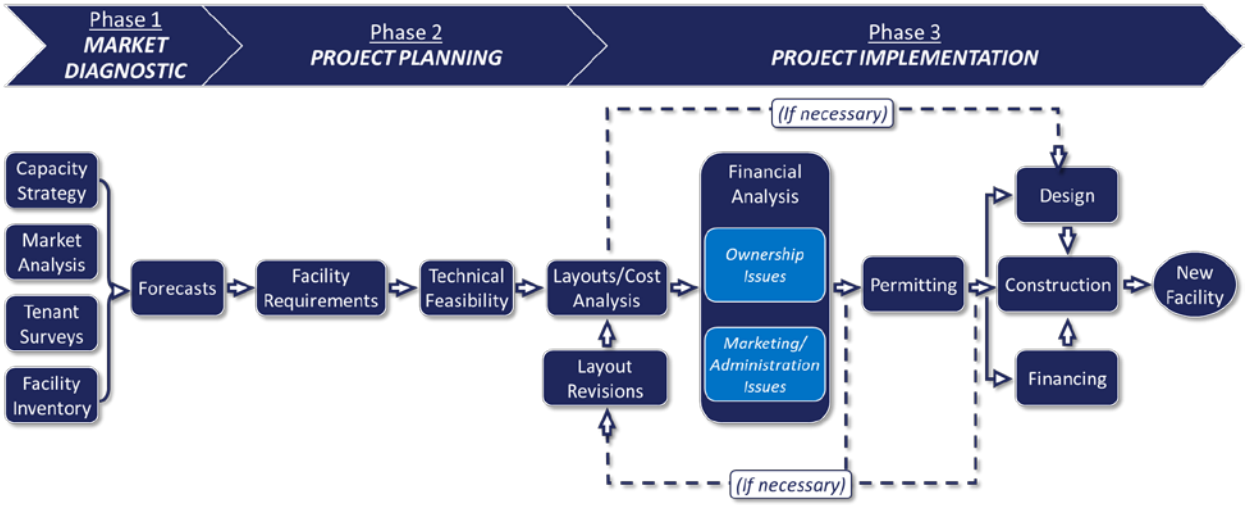

"WHAT IS THE MARKET FOR MY AIRPORT?"
PHASE ONE
MARKET DIAGNOSTIC
"HOW DO I DEVELOP MY MARKET?"
"WHAT ARE THE FACILITY REQUIREMENTS?"
"DO I HAVE THE RIGHT FACILITIES?"
PHASE TWO
MARKET STRATEGY DEVELOPMENT
FACILITY EVALUATION
CARGO FORECASTS/ SPECIAL FACILITIES
"HOW DO I SELL MY MARKET?"
"HOW DO I DEVELOP THE RIGHT FACILITIES?"
PHASE THREE
STRATEGY IMPLEMENTATION
FACILITY IMPLEMENTATION

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 is 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 have been consistently late in addressing cargo infrastructure demand while today overcapacity might be more the norm.

Almost any airport has the ability to 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. These factors will be discussed later.

Cargo facility shortage historically has been more of an issue than excess capacity situations by a significant margin. 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.

Returning to the earlier comment about 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 call is originated by an anonymous cargo customer and the message is clear: "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. One would also question the leadership of a department store embracing an inventory reorder policy dependent upon customer complaints of merchandise unavailability. Yet, 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.

The purpose of this section 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.

2.1 Capacity Impact

This analysis focuses on reducing potential capacity problems, whether it is a shortage or a surplus of facilities. A few words on the impact of these problems will help establish the urgency of preventive measures. Excess air cargo facility capacity, which appears to be the case at a number of airports today, is a serious problem. A multitude of factors have contributed to this particular 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 via a restricted service road is available. Freighter operators however, will seek to locate in a facility with contiguous parking apron, which offers operational and cost efficiencies. 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, which often negatively impact the airport. 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.

On the other hand, 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 an airport reach capacity, rental rates increase. The higher the rental rates, the higher the operating costs to 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 has been lost in this circumstance when the customer

went down the road 250 miles to an airport that had infrastructure available immediately. Cargo customers are not solely dependent on passenger preferences and, therefore, 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, which will come sooner or later. 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. The rhetorical question would be, "*Who could argue with that statement?*" The macro-analysis is of little help unless broken down into components with which everyone can deal.

Strategy Development

As discussed in the Introduction, 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. Since this is the most obvious population element, it usually receives a great deal of attention. 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. In comparison, fewer marketing resources are expended on the second element, the cargo carriers already utilizing the airport. 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 first priority is to ensure your existing customers are well served.

Significant resources are expended each year to attract new cargo customers; however, the first 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 must be evaluated to determine whether it provides an appropriate level

of efficiency for the existing cargo volumes and projected short-term growth and also whether the resources exist to support additional cargo customers.

First, ensure that existing users are being 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 the same concerns along to 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 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.

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Strategy Evaluation

Normally, those responsible and accountable for a strategy know whether it is producing 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 the success was attributable to other factors or that greater success could have been achieved. If the 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 in order to make adjustments.

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. Remember, change can have either a positive or negative impact on a facility. Identify potential sources of change and monitor those sources.

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). 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 (as with many other viable screening technologies) require a large footprint.

Currently, there are no regulations requiring screening of cargo prior to being transported on freighter aircraft. However, lawmakers continue to explore options to implementing regulations that would require on-airport screening. If new regulations are implemented, this could result in increased space requirements within air cargo buildings. Therefore, 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. Access to the AOA is more limited today, and the number of access points to the AOA has been reduced.

Change in Technology

Technology change 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. A 22-foot clear height was often efficient. Now a 22-foot clear height can lead to obsolescence. Not all technology has negative impact. 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 at a later date.

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.

Operational Concepts

Carriers are constantly seeking, and rapidly implementing, 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 have created a new generation of wide-body aircraft that have had a dramatic impact on cargo capacity, particularly at primary international gateways. Expanded belly capacity is reducing the need for freighters on some routes. This also creates the need for additional combination carrier cargo facilities 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 to achieve its objectives. The airport may represent one of the most important resources available to the local and regional economic development effort. Conversely, the economic development resources can prove a valuable economic and political ally to the airport. 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.

In summary, 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, your competition will.

Cargo infrastructure can actually, and often does, 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 the industry's history. This trend will continue, and if the airport cannot contribute to the above equation it 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. Nevertheless, there are other tools available, which can assist in measuring current utilization and comparing the result with industry norms. A brief word of caution on using norms in any analysis is in order. Since a norm is derived from a wide population of examples, it often lacks characteristics present in any single element within the population. Nonetheless, it can reveal a range of reasonable expectations.

"Norms" are only measurement devices and the only thing they measure is reasonableness of a very general population.

This section of the Air Cargo Facility Analysis addresses quantitative methodologies currently employed to approximate cargo facility requirements for airports. These techniques should be employed in conjunction with qualitative methods discussed in the Capacity Concepts section.

3.1 Total Land Area Requirements

One key factor that may be important to consider at the outset is understanding the total land area requirements for an air cargo facility.

At the macro, master plan 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 sufficient amount of 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; or 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. The 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. For example, a good rule of thumb 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. In this case, 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 US 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. However, that airport planners will need to coordinate the 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

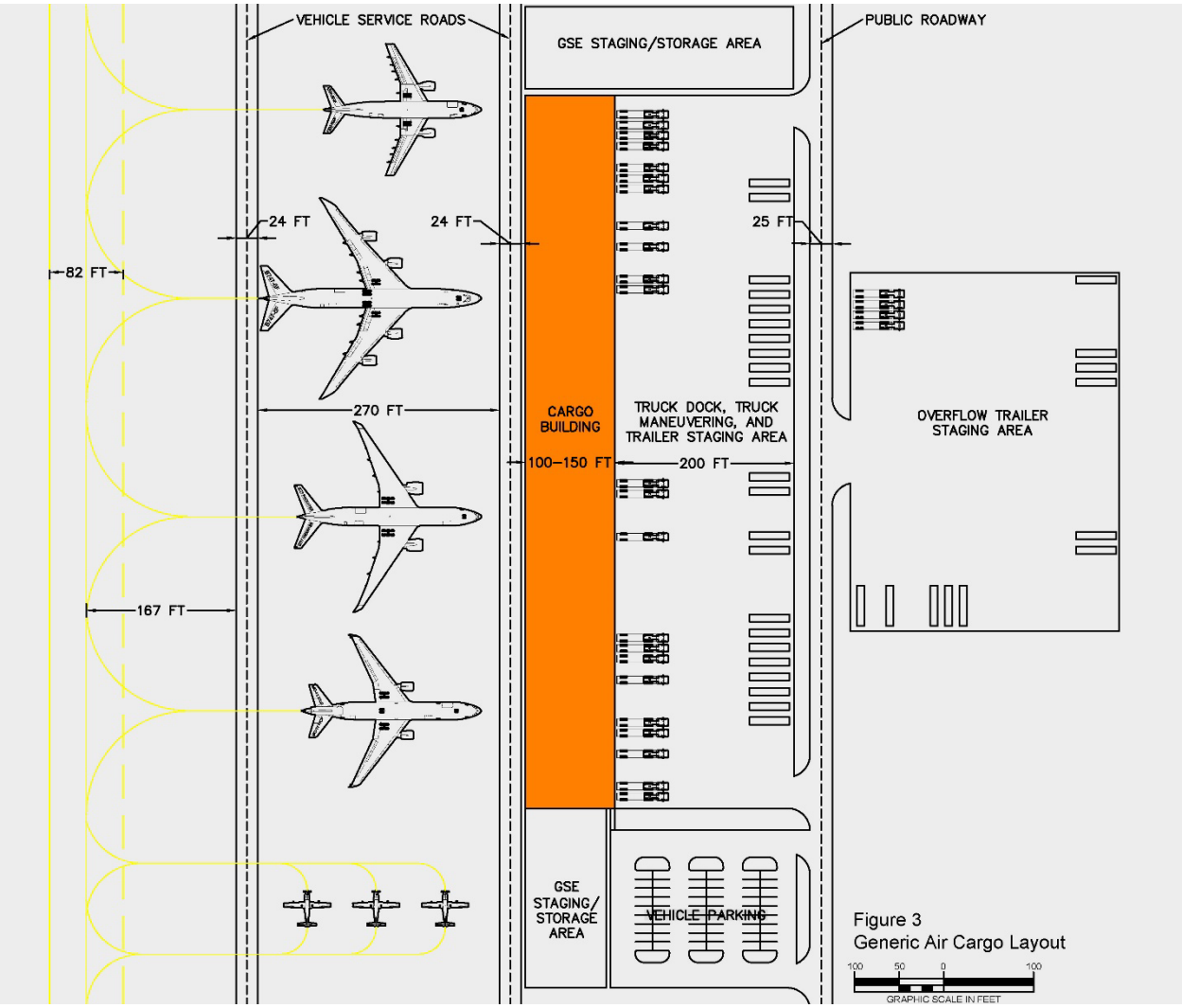
Applying functional area space metrics can be useful to determine the amount of space within a total site that should be allocated to achieve a balanced air cargo facility.

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 to the reader. As a 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. In many instances, adjustments must be made to reflect available site size and configuration as well as the nature of the cargo, e.g. an integrator building or mini hubbing operation may be more square to allow for sortation functions.



3.3 Cargo Operator Type

It is important to understand common characteristics associated with the different cargo carrier type is key to appropriately planning air cargo facilities. This is because the facilities associated with each carrier type tend to be configured differently based on the operational characteristics associated with each.

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. In general, the industry average cargo building utilization ranges from 1 to 2 tons per square foot. Cargo utilization can vary from airport-to-airport and facility-to-facility for a number of 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 buildings. These facilities tend to achieve greater space and processing utilization since a single entity controls all elements of the operation; therefore, 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 operational model – Integrated Cargo Carrier Type 1 and Integrated Cargo Carrier Type 2.

A key differentiating characteristic of Integrated Cargo Carrier Type 1 is that this operator type tends to process most, if not all, cargo on-airport, which generally results in a larger on-airport facility compared to Type 2. 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.

A key differentiating characteristic of Integrated Cargo Carrier Type 2 is that 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 mathematically 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.

Note that 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) will also need to be considered. A good rule of thumb for high-level space planning is 10 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.

Freight Cargo Facility Considerations

Freight cargo carriers are similar to integrated cargo carriers because cargo is carried on all-freighter aircraft; however, freight 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. Freight cargo facilities include an apron for aircraft parking, the cargo building, and landside area. In general, freight 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, and storage of cargo, and a container staging area. Belly cargo is usually tugged from the passenger terminal area where the aircraft is parked. These facilities therefore required access to the airside and efficient connectivity to the terminal.

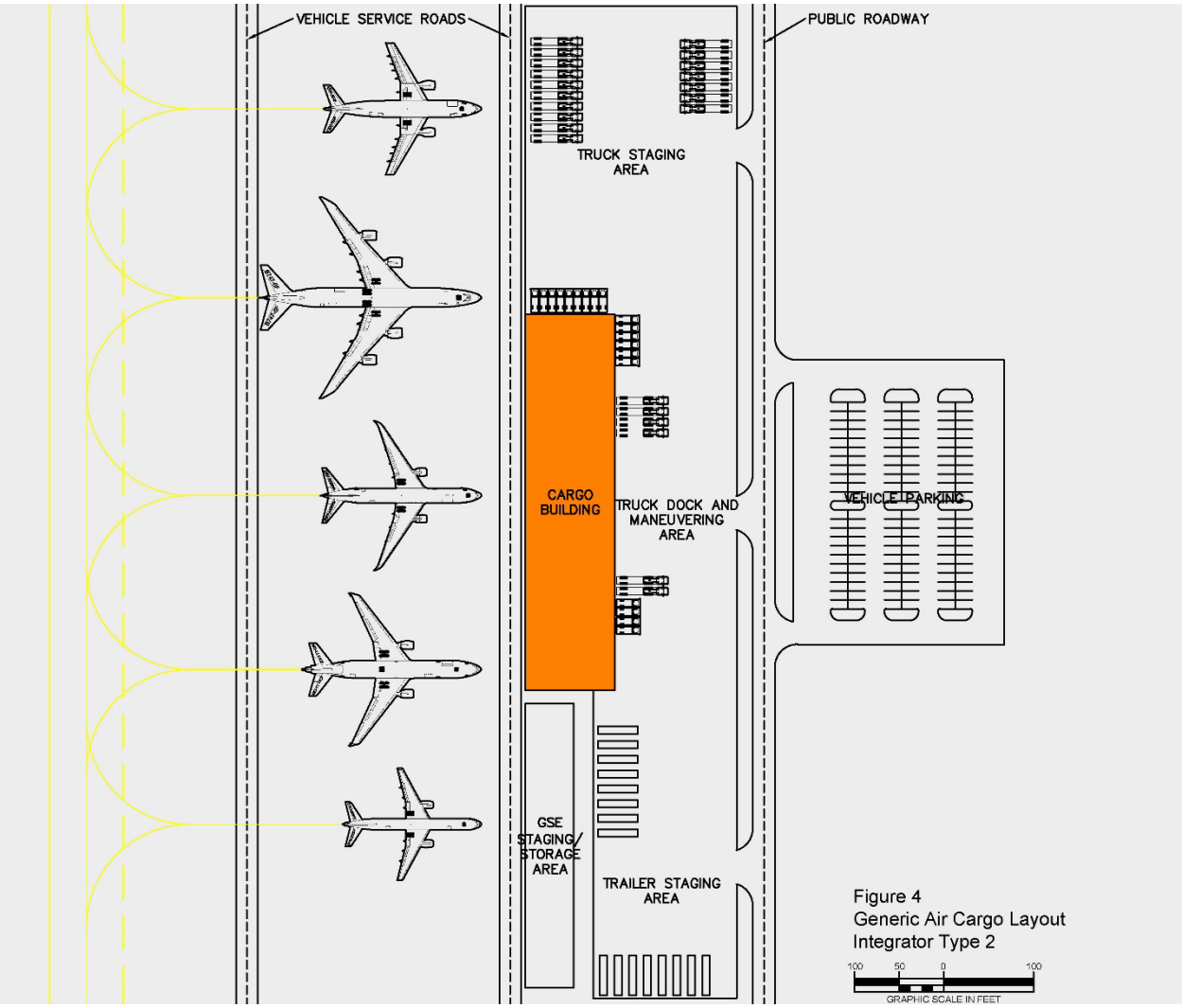


Figure 4
Generic Air Cargo Layout
Integrator Type 2

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, 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 measured by tonnage per square footage. 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 in excess of 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, subject to the specific requirements or circumstances of an airport. However, when dealing with an individual carrier, and particularly an integrator, you should develop a careful estimate of their actual physical requirements. 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. Also note that international cargo will typically have a lower throughput than domestic freight because of the higher clearance requirements to release the cargo.

3.5 Aircraft Parking Positions

Air cargo ramps vary considerably more in relation to cargo volumes than buildings, and, in part, 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/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 (i.e., Memphis, Louisville) are 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 will then put a dedicated aircraft into a market as that market grows. From the airport's perspective, there may be no additional apron requirement.

The trend for all cargo carriers is towards larger aircraft, not more aircraft.

Aircraft ramp space can vary based on the type of aircraft being operated. For purposes of air cargo, most aircraft fall into one of four categories determined by the FAA's Airport Reference Code ("ARC"). Code C aircraft, a Boeing 737, requires 2,300 square yards of ramp space. Code D aircraft, a Boeing 767 or Airbus A300, requires 3,900 square yards of ramp space. Code E aircraft, a Boeing 747, requires 6,500 square yards of ramp space. The Boeing 747- 8F is a Code F aircraft and requires 8,650 square yards of ramp. These criteria should be considered when determining future aircraft ramp space.

Despite the industry trend towards large aircraft, aircraft operators continue to rely on smaller aircraft for regional feeder transport operation. This regional transport role is commonly filled by turboprop aircraft such as the Cessna Caravan, Cessna SkyCourier, and ATR. There is also a growing interest in use of narrow-

body jet aircraft (e.g., Boeing 737) used as freighter aircraft to supplement a carrier's fleet of wide-body jets. Where practicable, airports should plan more apron space for these smaller cargo aircraft.

Currently, there are a number of information sources, which can assist the forecaster in benchmarking aircraft parking positions. The Official Airline Guide (OAG) can provide critical macro information on cargo operations at a particular location.

A forecast of air cargo tonnage can form the basis of a forecast for all-cargo hardstand position requirements at almost any airport. The methodology involves deriving all-cargo aircraft operations from the forecast of air cargo tonnage and then deriving hardstand requirements from all-cargo aircraft operations. It is however, essential to look at the contemplated size of the aircraft, and projected turn-times. It is also important to understand any potential issues with backhaul on a particular route.

Airbus Industries provides forecasts of revenue ton-kilometers and freighter aircraft. According to these forecasts, the ratio of revenue ton kilometers per all-cargo aircraft will continue to increase. The forecast takes into account both changes in average aircraft size and shifts in cargo tonnage between all-cargo aircraft and mixed-use aircraft. It can be assumed that the ratio of tonnage per all-cargo aircraft departures would increase at the same rate as the ratio of revenue ton kilometers per all-cargo aircraft. All-cargo aircraft departures can then be derived from the forecast of air cargo tonnage. It should also be noted that Airbus and Boeing are in business to sell aircraft.

Changes in air carrier schedules may alter the relationship between all-cargo aircraft operations and hardstand position requirements in the future. These schedule changes would be a function of individual airline marketing and routing decisions. Nevertheless, it cannot be assumed that all-cargo hardstand position requirements will increase at the same rate as all-cargo aircraft operations. For general purposes, a very rough rule of thumb for estimating apron requirements assumes 4.5 square feet of apron for every one square foot of available cargo building area. This must also consider the fleet mix of the potential tenants and users. This number includes aircraft marshalling areas and aircraft parking positions.

3.6 Landside Effectiveness

The biggest 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.

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. 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 doubling the number of truck dock spaces due to the enhanced truck utilization mentioned earlier, 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 trailer and tractor to smaller parcel delivery vehicles. The landside area of air cargo buildings (and truck docks) 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 height 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.

In addition to more trucks operating at airports in the future, which will likely require more truck docks, 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 will have to be considered. This includes remote lots that utilize shuttle services and rooftop parking. Typically plan on allocating 300sf per parking position. 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 Flow and Capacity

The capacity of airport roadways is based on a Level of Service (LOS) methodology found in the *Highway Capacity Manual*. Airport roadways are typically planned to accommodate LOS C. This level of service, a unit of measure of operations for a highway/street, represents a zone of stable flow in which speed and maneuverability are closely controlled by higher volume. Under LOS C, most drivers are restricted in their freedom to select their own speed, change lanes or pass. However, a relatively satisfactory operating speed along a particular section can still be maintained.

The projected volume of truck, employee, and customer traffic is based on a planning ratio of 0.95 peak hour vehicles per 1,000 square feet of cargo building space. This represents the volume in one direction. Most airports with dedicated cargo access roadways should have a minimum of two lanes, one in each direction, and provide the capability to expand to four lanes.

As with any rule-of-thumb methodology, benchmarking should be utilized cautiously and with an understanding it is not a precise measurement of any single situation. Benchmarking is most effective in preliminary planning and determining a range of reasonableness. It is not a substitute for detailed planning or examining factors that generate results outside a range of reasonableness.

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. Some of these operational issues 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 of the best ways to emphasize the need to 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 carriers now account for a majority of 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 when investment and resource allocation decisions are considered. 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 a growing air cargo industry.

Given what has occurred in the past decade, what trends are emerging that will again drive changes in the way airports must provide for the operating needs of the 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 will be 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, such as the Japan Airlines (JAL) facility at John F. Kennedy Airport (JFK), 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 efficiencies; 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. These facilities 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

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. By nature, 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. Typically, 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 operational 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 the e-commerce industry. E-commerce is a growing market segment that increases the demand for air cargo, particularly integrated carriers. McKinsey & Company, a management consulting organization, estimate that e-commerce will account for 20% of total air cargo volumes by 2022. This presents several challenges for the air cargo industry and on-airport facilities – namely, 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 results 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. Therefore, 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 as well as 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. Airport management can no longer view the investment impact and operating decisions solely within the confines of the airport boundary. 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 an important consideration for many 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 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 a regional sorting and distribution centers for cargo coming from multiple locations including the airport. The location, operation and access to the airport of such intermodal terminals will 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, force 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 the current condition 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 change. Consider how many cargo facilities developed over this time span fail to accommodate next-generation cargo aircraft. The simple issue of 5-10 more feet of tail height can make a facility obsolete or, at a minimum, much less efficient in the not-too-distant future due to setback requirements. This is just one example among many where planning and design seems to be done in a static environment.

The "traditional" single-level warehouses with truck docks on one side and aircraft parking apron on the opposite side ignore the evolution of the past decade and this supports the need to develop facilities that are flexible.

The purpose of this section is to identify recent 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 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 provides 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. Therefore, this section will also describe techniques for better utilization of existing airport land.

As 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, specialty items), ground handler (air-to-air, air-truck, air-sea interface), custom brokers (documentation service for the above) and specialized handlers (perishable products, livestock and quarantine items, 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 particular 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 updating process will significantly reduce the probability an infrastructure shortage will occur at the airport. This process involves, at a minimum, regular surveys of cargo carriers currently on the airport and those not presently using the airport. This survey process is conducted at the local, regional and national levels.

The survey 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.

Regular contact with the key planning and operational personnel of the carriers, at all levels is essential to determine the appropriate facilities.

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.

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 of these components can be broken down 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, airport management must both optimize-ensure that the highest and best use of airport property is achieved through proper placement of facilities--and maximize--develop facilities in a way that most efficiently uses the available property. This is very important with the development of cargo facilities since, unlike passenger demand, the shipper, ground handler, and airlines 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, yet have reasonably good access to the passenger terminals particularly when there is an emphasis on belly cargo. The air cargo zone and the surrounding compatible zones 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 taken into account in order 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 terminal building. More important to the all-cargo carriers is good access to the regional highway system. Often the integrated carriers 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. Where possible, the site should have 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 time 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 a potential for operational and safety violations and may be further constrained by future security guidelines

Carriers will generate increased volumes of on-road delivery vehicles and trucks… segregate this traffic from the passenger roadway access system if at all possible.

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 completely surrounded by a community that is resistant to expansion constraining the airport (physically or politically) to a very 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 projects. Having to import soil for a site is costly and could make a 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 particular 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 service segment has a significant bearing on facility location but the key is to keep the facilities close to the aircraft.

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. 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. Ideally, tug access roadways should not cross any active taxiways.

Compatibility of Uses and Potential Conflict

The airport must assess the complete spectrum of potential users in order 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 in order 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 any and all carriers.

- If possible, postal operations should be proximate to passenger terminals but away from air cargo aprons, except where mail is handled by an all-cargo or integrated carrier.

- 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 of the above and, therefore, 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.

In regard to airside circulation, many different business segments may require access to airside service roads. Depending on the type of tenant, the requirement for airside apron (marshalling areas) will vary. Ground handlers, mail facilities, and airline tenants (belly freight) 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.

As stated previously, airline tenants and ground handler must accommodate a variety of vehicles in their daily routines. Some tenants have a greater interface with the general public as customers and will require access and parking that are clearly differentiated from the everyday commercial traffic, as well as the employee parking facilities.

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 effectiveness. This section provides 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 HACTL facility at Hong Kong International Airport. 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 (the second busiest cargo airport in the world as measured by cargo volume).

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. These facilities can usually also be configured with demountable walls or partitions to easily adjust the internal building layout and separate tenants, if desired.

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 more common at all airports: the base tenant is a handling company and covers its costs through the imposition of handling fees.in the United States, like JFK and LAX.

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 shown in Figure 5, 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.

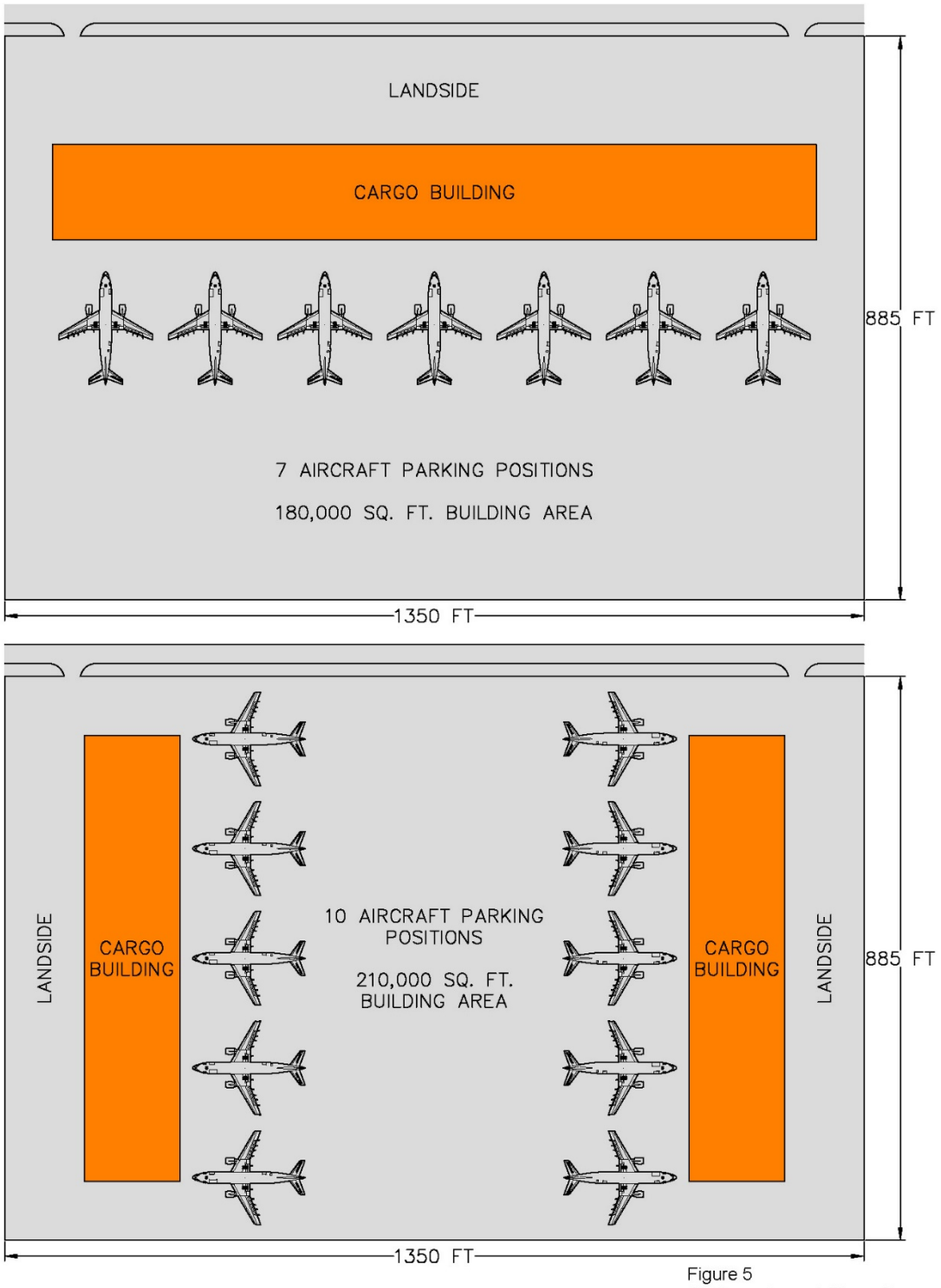


Figure 5
Air Cargo Layout Alternatives

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 and uses, 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. Although the concept is not new, it has gained popularity due to the significant cost savings to carriers. The concept recognizes that a great deal of warehouse space within a cargo facility is utilized during limited periods throughout the day and evening. The remainder of the time the space is idle. Specifically, it is the space used to build or breakdown pallets/containers and where cargo moves through the facility versus actual storage areas.

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.

One of the driving factors in the 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 as 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 take into account 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 associated 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

The purpose of this section is to identify existing planning parameters, identify trends that will impact these planning parameters, and recommend changes to these parameters to meet future cargo facility needs at airports.

Building Dimensions and Configuration

There are no hard and fast rules regarding the dimensions and configurations of air cargo buildings. Over the past 40 years, 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.

Aircraft Handstand Positions

It is important to realize early in the master-planning process the importance of ramp frontage. This may be compared to waterfront real estate. It is a limited commodity and must be used very efficiently. Hence, 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, 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.

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 recommended rule of thumb 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 10.

Equipment Staging Areas

There is often debate on the amount of equipment staging area that should be provided adjacent to the building. Once again, 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 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 becomes a supervision problem. Nevertheless, it is a design consideration.

"Murphy's Law" will prevail and tenants will use all allocated space and still need more.

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 so as to prevent hazardous substances from entering the natural drainage system as a result 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 circulation 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

Once again, 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 in consideration of 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 as a result of inadequate initial standards.

Employee/Customer Parking

Scarcity of land and development economics often result in design solutions whereby developing customer/employee parking areas becomes challenging. Nevertheless, 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 (though most of these will be off airport). In other words, the biggest change in air cargo at airports will be increased trucking activity.

The biggest change in air cargo will be increased trucking activity requiring expanded planning parameters and more integration of the activity on airports.

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. Clearly, trucking will have to become more integrated within the overall air cargo activity at an airport. As such, there must be adequate area on the landside to accommodate large volumes of truck traffic and, maybe more importantly, truck 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. The additional 200 feet would provide an area to store trucks 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 is 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 more mature 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.

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 encompass 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. The taxiway-to-fixed or movable object separation for the B747 is 160 feet.